New Junior Encyclopedia

Vol 7

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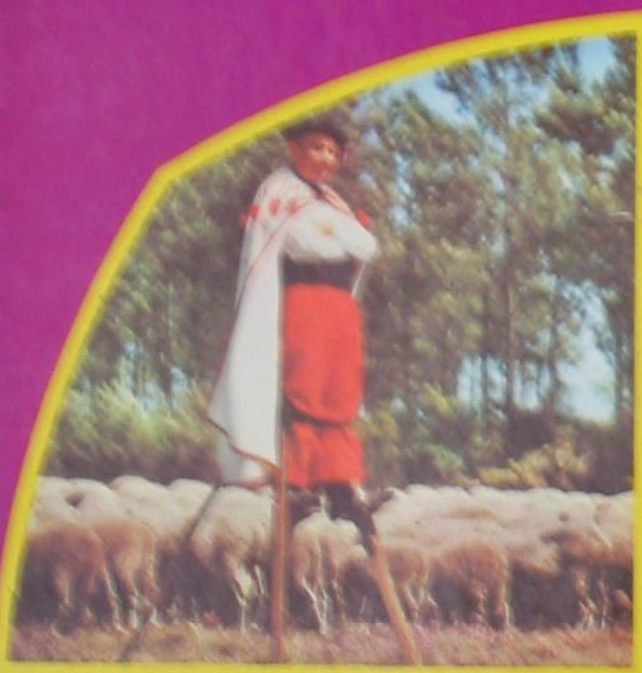

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Fife, a maritime county of eastern Scotland situated between the Firth of Forth and the Firth of Tay, is historically known as the Kingdom of Fife. Its county town is Cupar, and its population is 327,000.

The largest rivers in the county are the Eden and Leven. The valleys lying between the hill ridges are fertile and well cultivated. Coalmining is important, and there is some linen weaving and fishing. Towns include Kirkcaldy, Dunfermline and Cowdenbeath, and there is a new town at Glenrothes. St. Andrews is famous both for its university and for its championship golf course.

Fiji is a British Crown colony in the South Pacific Ocean. It is made up of about 322 largely volcanic islands in the Melanesian Archipelago. The group's area is 7,083 square miles, and its population is 476,000. The capital is Suva, on the island of Viti Levu.

Only about a hundred of the islands are inhabited. The larger ones are mountainous. Their southern and eastern sides are exposed to heavy rainfall, and dense jungle grows there. Short grass and reeds grow on the sheltered northern and western sides. The islanders grow bananas, coconuts, sugar cane, rice, fruit, cotton and vegetables. The main exports are *copra* (dried coconut kernel), coconut oil, sugar, bananas and gold.

About half the people are Indians. Fijians make up the rest, with some 10,000 Chinese and 7,000 Europeans.

The islands were discovered by Abel Tasman in 1643, and visited by James Cook in 1774. They were ceded to Britain in 1874.

Fingerprints provide a certain method of identifying any person. No two sets of fingerprints are the same. This fact is particularly useful in police work. Many criminals have been betrayed by the fingerprints they left behind.

Everyone has ridges on his finger-

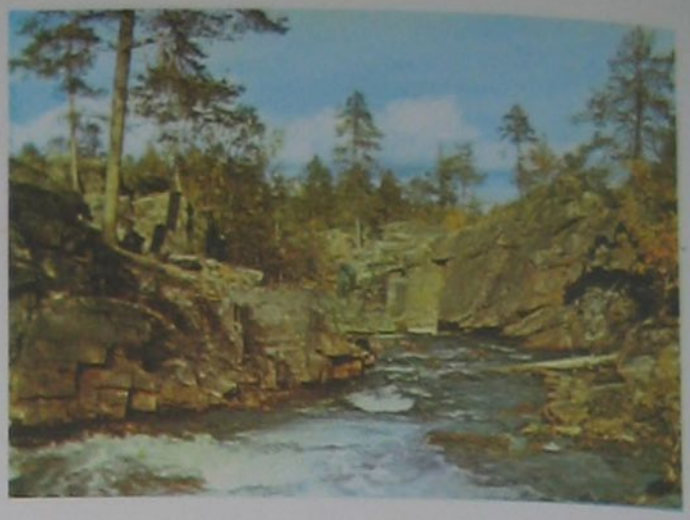
Fijian villagers, dressed in traditional fibre skirts, prepare for a 'fire-walking' ceremony over red-hot stones.

tips which form certain patterns. To describe these patterns, experts use the terms *arches*, *loops*, *whorls* and *composites*. Any set of fingerprints can be classified by these terms, and huge fingerprint files can be built up.

To take a person's fingerprints, police cover his finger-tips with printer's ink and then press them firmly on white paper, rolling the tips from side to side. The police can then compare his prints with those found at the scene of the crime. Such prints are sometimes invisible smudges, which are made visible when power is blown on them.

In Britain, Scotland Yard has a large fingerprint department. But the American FBI has the largest collection, with more than 150 million cards. Of these, a large proportion is of the armed services and civil servants. The ancient Chinese are believed to have been the first people to use fingerprints for identification.

A detective examines files of fingerprints, trying to identify the owner of a set under suspicion.



Left: Finland lies in northern Europe between Sweden and Russia. Above: A scene in the woods and forests that cover three-quarters of Finland. The country has many thousands of lakes.

Finland, in northern Europe, is a country of many lakes and forests. The northern part of Finland is north of the Arctic Circle. The country is bordered by Sweden on the north-west, Norway to the north and Russia to the east. Finland's coastline faces the Baltic Sea and the Gulf of Bothnia. In the Finnish language, the country's name is *Suomi*.

A low plateau covers most of the centre of the country. Most of Finland's 60,000 lakes lie in hollows worn in the rock by glaciers. Mountains rise in northern Finland, which is part of Lapland. Lapland is an area covering northern Norway, Sweden, Finland and part of Russia. About 2,000 Finnish Lapps roam the area. Plains lie in the south and west. Finland has warm summers and long, cold winters. The annual rainfall is about 20 inches.

Facts and Figures
Area: 130,120 square miles.
Population: 4,700,000.
Capital: Helsinki.

Above: A long Finnish boat, rowed by men in national dress. These boats are used at festivals.
Below: A sawmill on a lake shore.

Forests cover nearly three-quarters of the country and timber and wood products are Finland's main exports. The many mineral deposits are still being developed. Less than a tenth of the land can be farmed, but crops ripen quickly because the summer days are very long. Finland exports butter. Industry is generally based on forest products. Power comes largely from hydro-electric plants.

Most Finns are fair-haired and blue-eyed. Many of them speak two languages, Finnish and Swedish. Most Finns are Christians. Finland is a republic. The people elect a one-chamber parliament and a president.

The first Finns were wandering tribesmen who moved into Finland about 2,000 years ago. They were united under Swedish rule from the 1100's until 1809, when Russia seized the country. Finland remained part of Russia until World War I, when it broke away from Russia and became a republic.

During the years of World War II, Finland fought two wars with Russia and lost both. Russia took a large area of Finnish territory. In 1961, Finland became an associate member of the European Free Trade Association.

Fiord During the Great Ice Age about a million years ago, more than 8 million square miles of Asia, Europe, and North America was covered by enormous sheets of ice. As the ice melted and receded it left behind many *glaciers* (rivers of slow-moving ice). Fed by the ice-caps and high snow-fields, these glaciers slowly ran down former river valleys to the sea. The floor and sides of such a valley were gradually *eroded* (worn away) by the movement of the ice and the abrasive rock debris carried in it. The disappearance of the ice revealed the characteristic *glacial valley* with its U-shaped section, rock-strewn floor, and tall, steep sides.

A beautiful fiord in Norway.

In countries where the mountains extend right to the sea-coast, such as Greenland and Norway, these glacial valleys have been flooded by the sea to form great inlets, called *fiords*, in the mountainous coastline.

The flooding of the fiords was partly caused because the ice carved out the valley to below the level of the sea for some distance inland from the coast. This 'over-deepening' arose because the ice could not float until it was almost submerged. The deep basin made in this way, when flooded by the sea, formed a deep inlet stretching far inland.

Many fiords have a shallow *threshold*, however, near their mouth. This is because the glacier became thinner as it reached the sea, and a bar of debris accumulated there almost up to sea level.

A London fire engine waits ready to race to a fire. With bells ringing and warning lights flashing, the vehicle may rush through traffic, ignoring normal traffic rules.

Fire was first known to Man as a terrifying natural force. It came in a lightning flash from the sky. It belched forth from volcanoes while the ground shook. Forest fires sprang up like magic in dry weather, consuming all in their path. Men and all the other animals used to run for their lives. Then, slowly, Man realized that fire could keep him warm in winter and give him light in the darkness. It would give him protection by frightening off wild beasts. Later, he found that food was much tastier when cooked over a fire.

At first, Man had to rely on Nature to start his fires and had to try to keep them going. Then he discovered how he could make fire himself. One way was to rub or twirl one piece of wood against another. This produced heat (by friction) and made the wood glow. Blowing fanned the glow into flames.

The other way of making fire was to strike one kind of stone (flint) against another (iron pyrites) to make sparks. He directed the sparks onto very dry leaves and set them on fire. This method formed the basis of fire-making right until the 1800's. *Tinderboxes* were used to hold dry kindling. Today, cigarette lighters work on the spark principle. A wheel rubs against a flint and produces sparks to set fire to a wick or a gas.

But the main way of making fire since about 1830 has been with *matches*. Rubbing the head of the match against a rough surface produces heat, which sets fire to a chemical and then to the stick.

Talking points

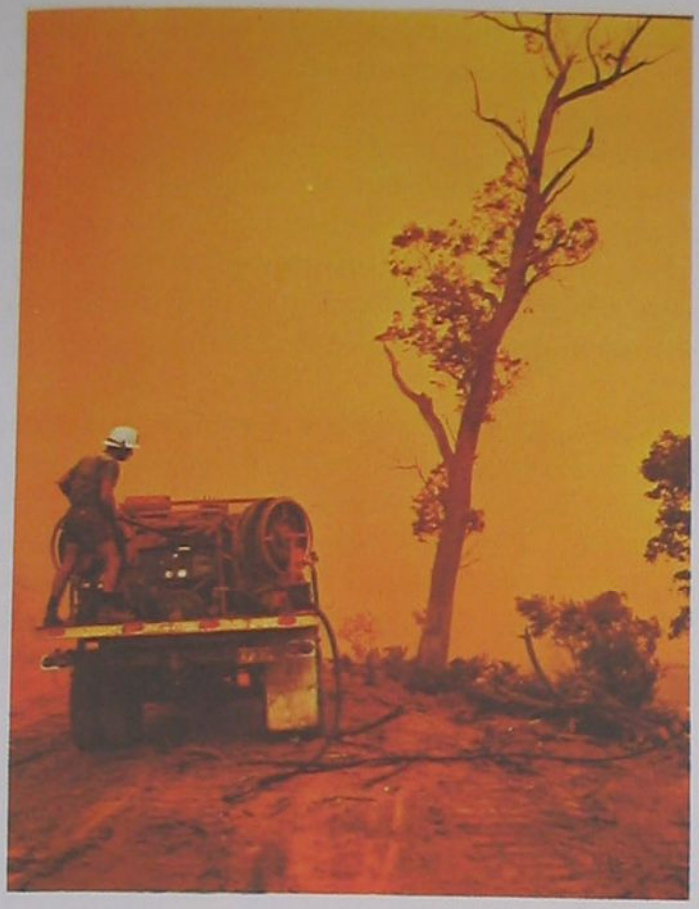
* The discovery of fire was one of the most important advances made by early Man. Discuss how he might have discovered the uses of fire and how he learned to make it.
* In schools and public buildings there should be instructions for what to do in case a fire breaks out. Make sure you are familiar with these instructions when you are in such a place.
* Different materials ignite (burst into flames) at different temperatures. For example, paper burns at a quarter of the temperature needed to ignite natural gas. What uses are we able to make of this fact?

Articles to read

Bush fires; Fire-fighting; Heat.

Fire-fighting When it is under control fire might be called man's best friend. But once it gets out of control, it is undoubtedly his worst enemy. Every year, fires kill and maim; they destroy buildings and lay waste forests.

Today, when we see a fire starting, we call the fire brigade. Within minutes, a fire engine races up, and firemen begin to put out the blaze. Years ago, things were rather different. Whole cities burned down because there was no organized way of fighting fires. It was not until after the Great Fire of London (1666) that fire insurance companies arose and formed fire-fighting units.



Above: Fire-fighting equipment must be tested to make sure that it is effective. These firemen are demonstrating mobile appliances on a burning disused Buccaneer aircraft. Left: In the hot dry climate of Australia, fires are liable to break out and consume large areas of forest and brush. One way of controlling these fires is to clear a wide band in the forest that cannot be crossed by fire.

Fire-fighters have to work particularly hard in wartime. Incendiary bombs are dropped to start fires and enable enemy bombers to spot their targets. Below: A fireman works to extinguish a church fire during World War II.

The early brigades had simple hand pumps. Modern fire engines have powered pumps that can pour 1,000 gallons a minute on to a blaze. But water cannot always be used on fires. For oil fires, firemen use fire extinguishers which throw a thick blanket of foam or inert gas (carbon dioxide) on the blazing oil. Electrical fires need special treatment, too.

Fighting forest fires is particularly difficult. The fires are usually in remote regions where there are no roads, and fire fighters have to be parachuted to the fire. They can seldom control it directly. They have to clear a wide band of forest in front of the fire to act as a *firebreak.* Oil-well fires, too, cannot generally be controlled by normal methods. Often the only way to put them out is to blast in the sides of the borehole.

Fire is difficult to control once it gets a hold, and for that reason factories, stores, ships and aircraft have many devices to prevent fire and to limit its spread. Large buildings and ships have water *sprinkler* systems which come on automatically and sound alarms if the temperature rises dangerously. They also have fire doors for isolating the affected sections. Aircraft have many devices that warn the pilot of dangerous rises in temperature. At especially dangerous points, such as the engines, there are automatic extinguishing systems.

Fireworks form fountain patterns in the sky. Fireworks can be dangerous and must be handled with great care.

Fireworks, made of gunpowder and other chemicals, are designed to produce loud noises and bursts of coloured light when set off. The art of using fireworks is called *pyrotechnics.* Dazzling displays of rockets, firecrackers, wheels, stars, sparklers and Roman candles are traditional in many countries for the celebration of holidays and festivals.

Flares, which are a form of fireworks, are used as signals by ships and lifeboats, and by military forces in wartime. The Chinese used gunpowder and fireworks as early as the 800's A.D.

First Aid is emergency treatment given to an injured person before the arrival of a doctor. Immediate first aid can sometimes save a person's life. An important first aid technique is *artificial respiration,* which is used to restore breathing after drowning or electrocution. One method of artificial respiration, called 'the kiss of life', is to breathe directly into the victim's mouth.

For small wounds pressure is usually applied to stop the bleeding, but large wounds may require a *tourniquet* to cut off the blood supply. A tourniquet is a tight strap or bandage that cuts off the blood supply to an injured limb, and consequently prevents serious loss of blood. But a tourniquet must only be applied for a short time.

Wounds should be cleansed and covered with bandages or dressings. Another condition requiring immediate attention is poisoning. If conscious, a person who has swallowed poison should be made to drink several glasses of water or milk.

Every first aid box should include the items shown above.

Sometimes the most important first aid treatment is to stop an injured person from being moved or otherwise disturbed. A person who is unconscious should not be fed any liquids or solids. Usually it is best not to try to move anyone who may have a broken bone.

In every injury, a psychological reaction known as *shock* occurs. This can be a mild paling and feeling of cold, or a more severe reaction in which the patient becomes weak, numbed and unresponsive. Treatment of shock is always part of first aid. The patient should be kept warm with blankets or jackets, and given warm drinks. If possible, he should lie down, with his head lower than his feet.

Because first aid is only temporary help, it is always necessary to make sure that someone has gone for a doctor.

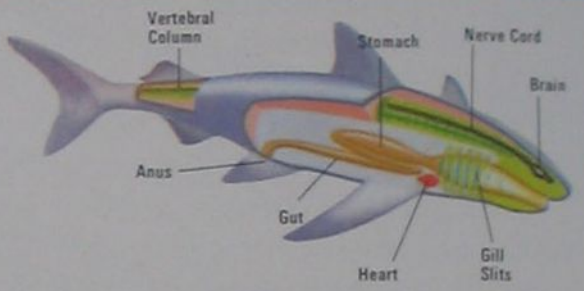
Fishes are vertebrates (animals with backbones). There are nearly 25,000 species of fishes known—more than the number of amphibians, reptiles, birds, and mammals (the other backboned animals) put together. Fishes can be grouped into *fresh-water* and *salt-water* fishes. But as some fishes can live in both kinds of water, scientists prefer to classify fishes by their body structure into three classes. The majority of fishes are *bony* fishes—they have skeletons made of bone. The *cartilaginous* fishes—sharks, skates, and rays—have skeletons of cartilage, a gristly substance. The lampreys and hagfish are *jawless* fishes with cartilaginous skeletons.

Fishes are particularly important to man as food. They are rich in protein and certain vitamins. Some people get pleasure from fishing as a sport, but to many it is a living. Fishes are cold-blooded animals—their bodies take on the temperature of the water surrounding them.

A fish moves through the water by bending its body to and fro, and by moving its tail. The *dorsal* fins, along the topside of the body, and the *anal* fin, on the underside just in front of the tail, help to keep the fish on an even keel. The two *pelvic*

fins in the middle of the underside and the pair of *pectoral* fins just behind the head control vertical movement and also act as brakes. Turning movements are controlled by the tail and the pectoral fins.

Most fishes are covered with scales, although they are always born without them. A fish, unlike other backboned animals, goes on increasing in size all its life. But the scales do not increase in number; they merely get bigger. In most bony fishes, there is a line of special scales along the middle of the body. This line is called the *lateral line*, and through

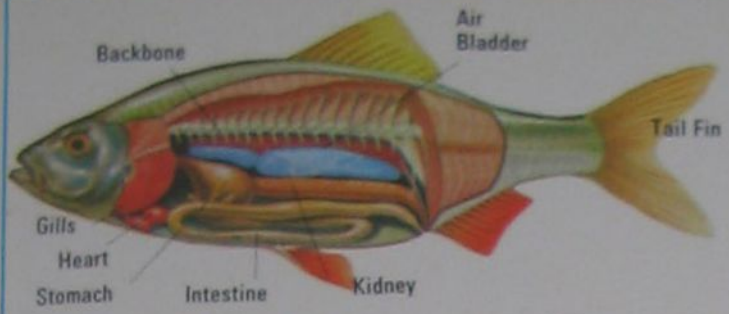


The internal organs of the shark, a cartilaginous fish

these nerve scales a fish can sense vibrations in the water.

The fish's internal organs are similar to those of other backboned animals. The kidney has an additional function of maintaining the correct proportion of salt in the blood, depending on whether the fish lives in salt water or fresh water. Bony fishes have an additional body organ to those of other animals: the *swim-bladder*. This is a small bladder of gas that gives the fish the *buoyancy* required at whatever depth it is swimming.

Fishes obtain oxygen from the water by means of *gills*. These are feathery structures behind the head which, except in the cartilaginous fishes, are covered by a flap called the *operculum*. The gills are fed with blood from the heart. In the gills, oxygen passes from the water into the blood. Several aquatic creatures that look like large fishes have lungs instead of gills and have to surface to breathe. These animals, such as whales and porpoises, are in fact mammals.



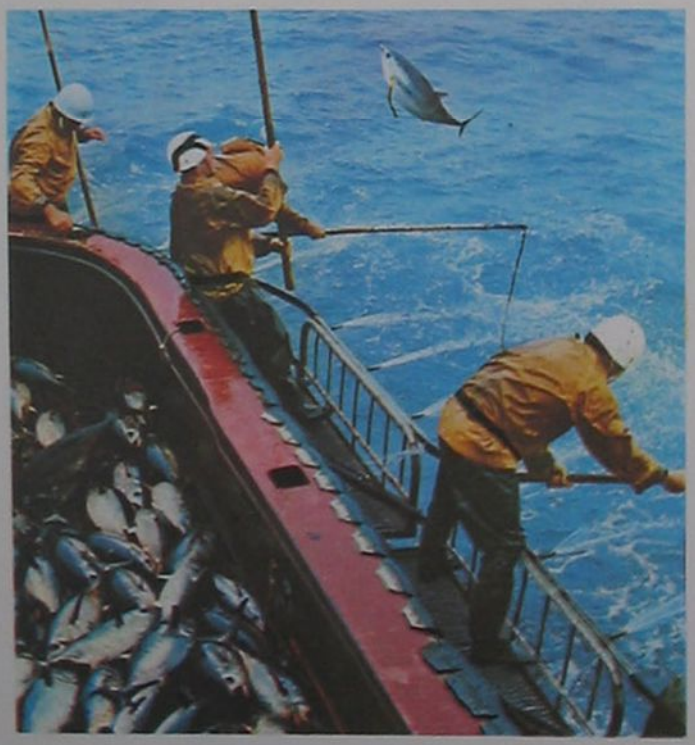
The internal organs of the carp, a bony fish

Most fishes have eyes situated at the sides of the head so that they have vision over a wide field. They can see in colour. Many adopt bright colours which attract mates, while others have colours that merge with the surroundings as protection from attack. Hearing is not well developed in fishes, although they sense vibrations with the lateral line. The sense of smell can be very acute, and many fishes, such as sharks, hunt only by smell.

Almost all fishes hatch from eggs, but the ways in which the parents care for them vary enormously. Many produce millions of eggs at a single spawning, leaving the eggs and newly-hatched fish unprotected. Few of these millions survive. If all did, the world's oceans would soon become full of fish. Other fishes are more involved with their young. Some sticklebacks build nests for their eggs, and the male keeps guard over the eggs and young fish. The male pipefish and the male sea-horse carry the eggs in a brood pouch on the underside of the body, in which the eggs hatch. Some catfishes and mouthbreeders, both male and female, carry the fertilized eggs in their mouths. The female butterfish moulds her eggs into a ball by coiling herself around them, and guards them until they hatch. The male Siamese fighting fish makes a nest of bubbles at the surface and puts the eggs into the nest from its mouth. It then keeps guard over the nest, replacing any eggs that fall out.

A few fishes bear living young. These include several popular aquarium fishes such as the guppy, and some sharks. Some

Above: Traditional sea-going junks under full sail at Macao, on the southern coast of China. These boats can be used as fishing vessels. Left: Gutting herrings by hand at the fishing port. Below: Poling tunny fish or tuna off the coast of New South Wales in Australia.



fishes, such as skates and dogfish, lay their eggs in horny cases popularly called 'mermaids' purses', which can be found on the seashore.

The size of adult fishes varies greatly. Some gobies never exceed half an inch in length, while the whale shark grows to a length of 40 feet.

Many fishes have strange habits fitted to their mode of life. The flying fish can glide for up to 150 yards over the waves, using its pectoral fins as wings. The archer fish can catch insects by squirting water at them. The mudskipper can crawl about the land and even up trees, staying alive by retaining water in its gills. The four-eyed fish can see both in and out of the water with its special eyes, and the puffer fish blows itself into a ball which scares away attackers.

Talking points

* The supply of fish in the sea is not limitless. Over-fishing and water pollution have seriously depleted the stocks of fish in some parts of the world – notably the Mediterranean. Discuss what measures you think should be taken to avoid exhausting this valuable source of food.
* Some countries have recently decreed offshore limits of 12 miles, and in the case of Iceland, 50 miles, within which only their own trawlers may fish. Do you think that they have a right to do this?
* Fish go bad quickly after being landed. What methods can be used to make sure that the fish will reach inland markets in a fresh condition?

Articles to read

Angling; Fishing; Food preservation; Whales.

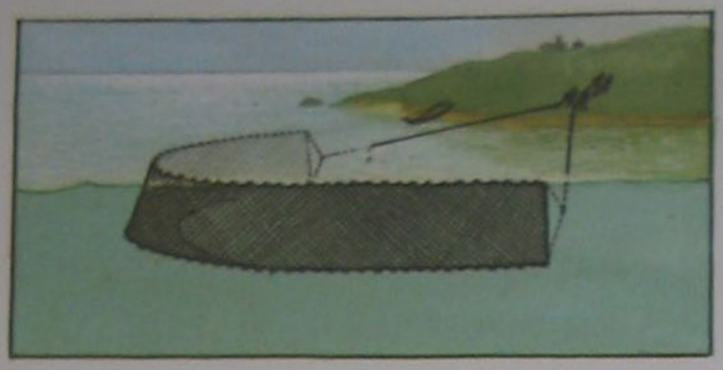
Fishing provides about three per cent of the world's total food production. In some maritime countries, fish may account for up to 10 per cent of the food eaten. The most important food fish are cod, herring, flat fish such as plaice and sole, sardine and tunny (tuna).

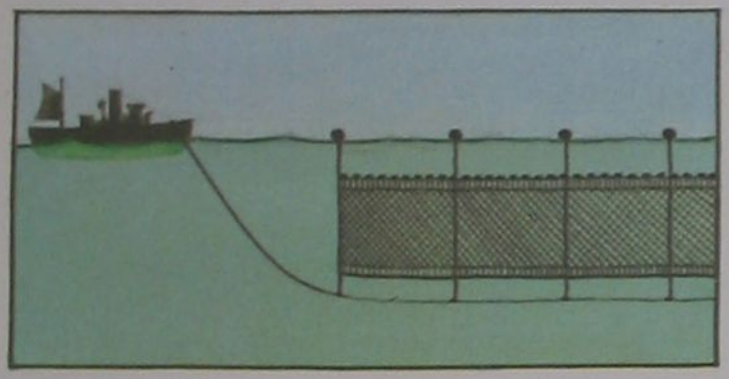
About 90 per cent of the fish caught commercially are fished from the sea. The great fishing grounds are the North Atlantic near Iceland and Newfoundland, the North Pacific near Japan and Russia, and the eastern Pacific off Central and South America. The leading fish-catching countries border these fishing grounds. They are Japan, China, Russia, the United States, Peru and Norway.

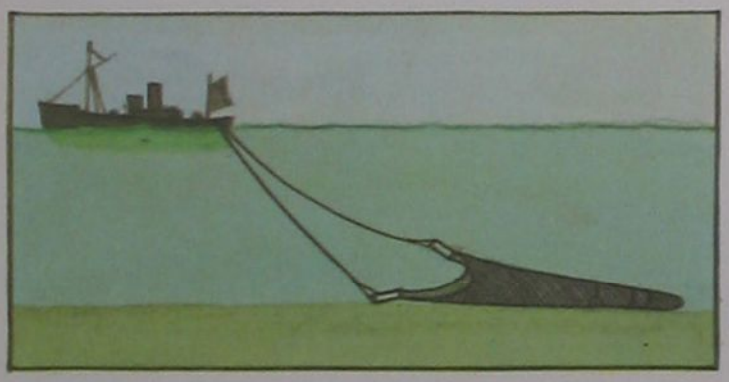
The uses to which the catch is put vary from country to country. Most of Japan's fish is eaten – more fish than meat is eaten

Opposite: Icelandic fishermen with a catch of herrings ready to be unloaded. The fish must be graded and then packed into boxes with ice before being sent to market.

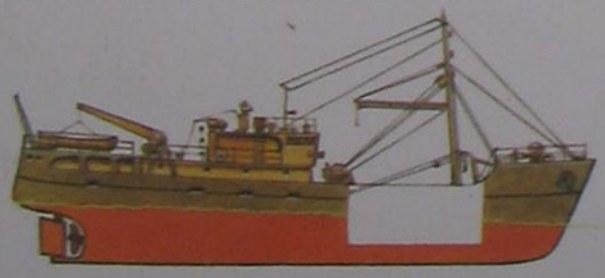
HÚNI







Top: Drawing in a long seine net from the shore. Fish are trapped in the loop. Centre: Drift nets float beneath buoys, trapping fish that swim into them. They are attached to boats called drifters. Bottom: Trawls are large, bag-shaped nets dragged along the sea-bed or in mid-water by a trawler. Below: A view of a deep-sea trawler showing the position of the hold.



in Japan. In Peru, much fish is used to make fish meal, which is used as a fertilizer or to feed animals. In China, fish is caught for food in the coastal waters and in fresh waters inland. Russia has a large fishing fleet to provide fish for home consumption. The United States imports fish for food, because nearly half its own catch is used for making fish meal and fish oil. Norway catches a lot of fish, but most is exported to other countries.

There are three main ways of catching fish commercially. The most important of these methods is snaring by nets. The other two methods are luring fish on to hooks and directly attacking the fish.

There are many different kinds of nets. *Trawls* are huge, long bag-shaped nets that are dragged along the sea bed or in mid-water by a small fishing vessel called a *trawler*. Another way of using nets from a boat is called *seining*. A *purse seine net* is a huge net lowered into the sea. When a shoal of fish swims over it, the net is raised quickly and drawn together, trapping the fish inside. *Long seine nets* can be used from the shore by rowing out and back again in a huge arc, paying out the net behind to form a great loop. The two ends of the loop are then pulled in, trapping fish in the net. *Drift nets*, as their name implies, are large nets left to drift in the sea. Attached to a drifter, the net is left in the sea for a long time and the fish trap themselves in it. *Gill nets* are nets like drift nets, and are used in river estuaries or shallow tidal waters.

Trolling is a method of fishing by lures. Long lines with baited hooks are pulled behind a boat. In long-line fishing, a long baited line is laid on the sea-bed and marked by buoys.

Direct attacking of fish is the basis of big game fishing. And in the Mediterranean, fishermen go out at night in boats with huge carbide lamps suspended over the bows. The lamps light up the bottom, and fish can be easily seen and speared or trapped.

Once the fish have been caught and hauled on board the fishing vessel, they must be preserved if the boat is a long way from port. Modern fishing boats have refrigerated holds. Some wash, clean

and grade the fish so that it is ready for sale. Once ashore, the fish are either rushed fresh to fishmongers throughout the country, or they are quick-frozen, canned or cured.

Curing is a way of preserving fish by drying, salting, or smoking. Kippers, for example, are smoked herrings.

Flags A flag is a piece of material, usually an oblong of cloth, which stands for a particular thing, such as a nation, group, person or idea. A national flag, for example, represents the entire nation—not only its ideals, but also its prestige and power, its government and its people. Flags are flown on festive occasions, and to welcome important visitors from other countries. When someone very important dies, flags may be flown at half mast—that is, half way down the flag pole—as a sign of mourning.

The ancient Egyptians were the first people to fly flaglike streamers. These were attached to long poles or *standards*, and were used in battle—a practice that continued throughout history. Each side had its *standard-bearer*, who held the standard high for all to see. This helped soldiers to find their comrades quickly. The idea behind the saying, 'Rally round the flag, boys,' is many centuries old.

Flags have always been important as a means of identifying ships. Particularly in wartime, it may be necessary to know under what country's flag a ship is sailing, before coming too close. Sailors also use flags for sending messages in the International Flag Code.

The most familiar flags in the modern world are those of nations and of international organizations such as the United Nations and the Red Cross. Most of these are oblong in shape. The section of the flag nearest the staff is called the *hoist*, while the part which hangs free is called the *fly*. Each national flag has its own distinctive design, which is repeated on both sides of the material.

Sometimes there is a story explaining how a design came to be used. The oldest national flag is Denmark's, which has had the same design for over 700 years. Its story is as follows: King Valdemar the Victorious was at war. Looking upwards, he saw a white cross against a red sky. He took this to be a sign from heaven, and he won his battle. And in 1219, Denmark adopted the white cross on a red background for their flag.

Flags of the states of Australia fly outside Parliament House, Canberra.

Afghanistan

Bulgaria

Czechoslovakia

Germany, East

Ireland

Albania

Burma

Denmark

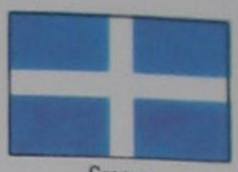
Ghana

Ireland, Northern

Algeria

Canada

Ecuador
(Merchant Flag)


Greece

Israel

Argentina

Ceylon
(Sri Lanka)

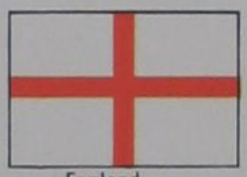
Egypt (U.A.R.)

Hungary

Italy

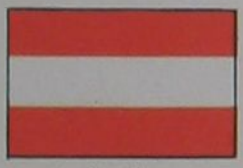
Australia

Chile


England
(St. George)

Iceland

Jamaica


Austria

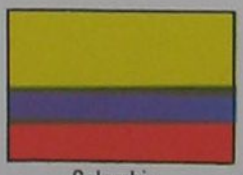
China
(Republic)

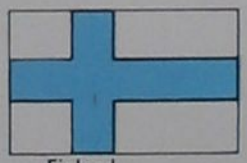
Ethiopia
(Merchant Flag)

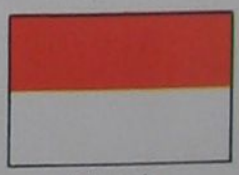
India

Japan

Belgium


Colombia


Finland
(Merchant Flag)

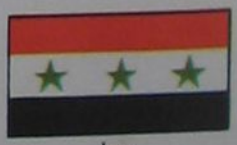

Indonesia

Jordan

Bolivia
(Merchant Flag)

Cuba

France

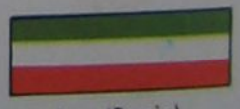

Iraq

Korea, North

Brazil

Cyprus

Germany, West


Iran (Persia)

Korea, South

FLAGS OF THE WORLD

Lebanon

New Zealand
(Government Flag)

Rhodesia

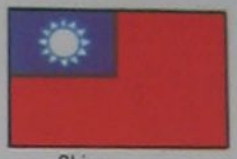
Switzerland

Uruguay

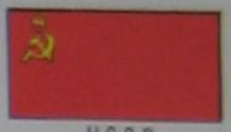
Liberia

Nigeria

Rumania



China
(Nationalist)



U.S.S.R.

Liechtenstein

Norway

Saudi Arabia

Thailand (Siam)

Vatican City

Luxemburg
(Standard of the
Grand Duke)

Pakistan

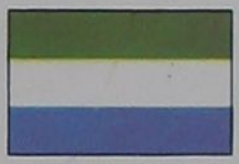
Scotland

Tonga

Venezuela
(Merchant Flag)

Malaysia

Paraguay



Sierra Leone

Trinidad &
Tobago

Vietnam, North

Malta

Peru
(Merchant Flag)

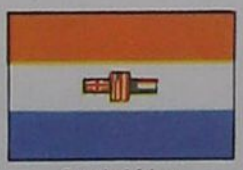
Singapore

Tunisia

Vietnam, South

Mexico

Philippines

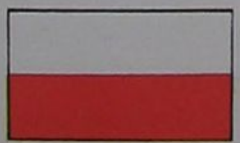


South Africa

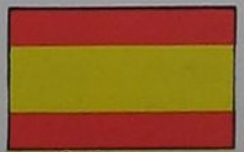
Turkey

Wales

Morocco



Poland



Spain
(Merchant Flag)

United Kingdom

Yugoslavia
(Merchant Flag)

Netherlands

Portugal

Sweden

United States

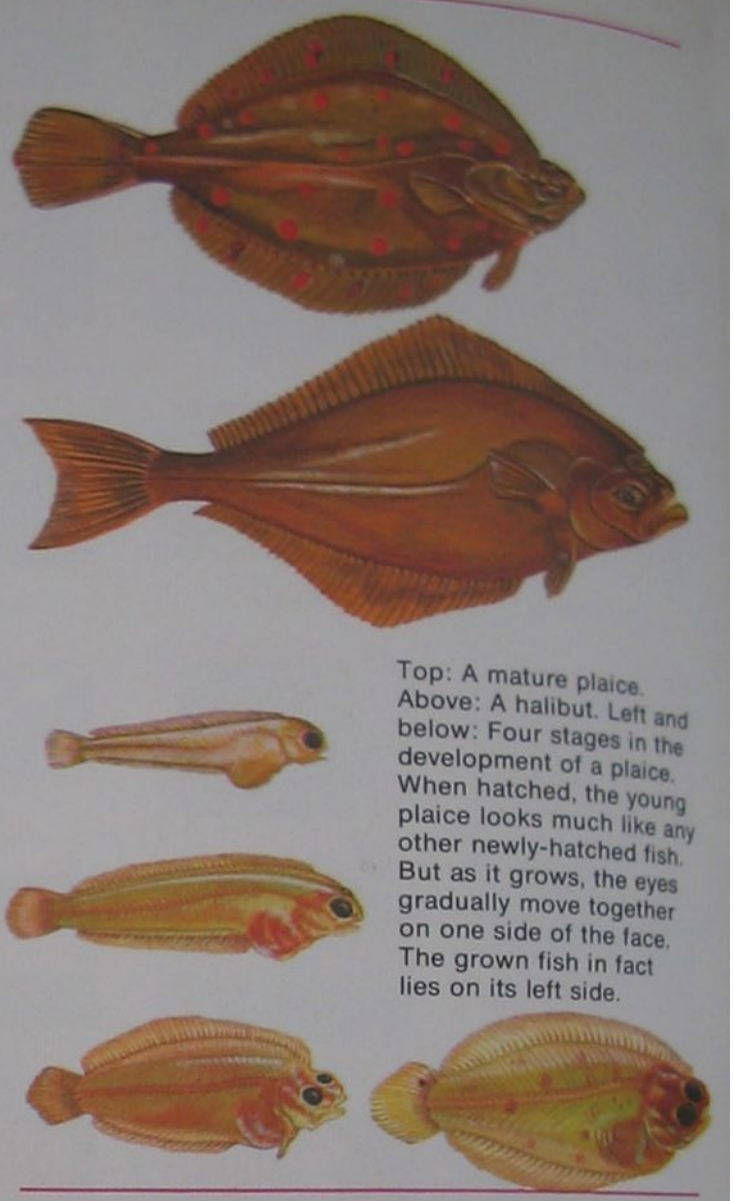
Zaire

United Nations

Some national flags have origins deep in history. The crest on the Austrian flag dates from the 1100's. Among the earliest flags was that of Ancient Rome, which bore the letters SPQR, standing for the 'Senate and People of Rome'. Some countries, such as the United States have made laws to ensure that the national flag is treated with respect.

The cross as a Christian symbol is found on many flags. Great Britain's flag, the Union flag or 'Union Jack', combines the crosses of St. George, St. Andrew and St. Patrick. Other religious symbols include the crescent moon, a sacred Muslim sign which appears on the flags of some Arab nations; the rising sun, found on several Asian flags; and the six-pointed Star of David, featured on the Israeli flag.

Ordinary stars have a different meaning. One star stands for unity, while many stars may show the number of states or territories united in one country. Similarly, the colours used in many modern flags have a symbolic meaning. The colours red, white, green and black stand for Arab unity in the flags of such countries as Egypt, Jordan and Syria.



Top: A mature plaice. Above: A halibut. Left and below: Four stages in the development of a plaice. When hatched, the young plaice looks much like any other newly-hatched fish. But as it grows, the eyes gradually move together on one side of the face. The grown fish in fact lies on its left side.

Flatfishes are bottom-living marine fishes with a body compressed almost flat. True flatfishes, in fact, lie on their side, with both eyes on the upper-side. This may be either the right side or the left side. When a flatfish is born, it resembles other young fish. But as it grows, its eyes gradually move together on to one side of the body, and its mouth becomes twisted. Skates and rays are also flat but they are flattened from top to bottom, not from side to side. Flatfishes have developed an unusual method of protection. They often lie almost invisible on the sea bed as the upper-side changes colour to match the surroundings.

Flatfishes are found near the coast in most seas and oceans. Many of them are important food fishes, and they are usually about one to two feet long. The halibut is the largest flatfish; it normally grows to a length of seven feet, but halibuts twice this size have been caught. Other flatfishes include the plaice, flounder, dab, sole and turbot. There are about 600 species of flatfishes altogether.

Flies are insects belonging to the order *Diptera*, meaning 'two wings'. A fly has one pair of true wings, and behind them a pair of small club-shaped wings called *halteres* that help the fly to keep its balance while flying.

Flies are the most dangerous of insects, not so much because they harm man directly, but because many flies carry harmful germs and spread diseases. Houseflies and blowflies or bluebottles live around human dwellings, infecting meat and other food. In the tropics, mos-

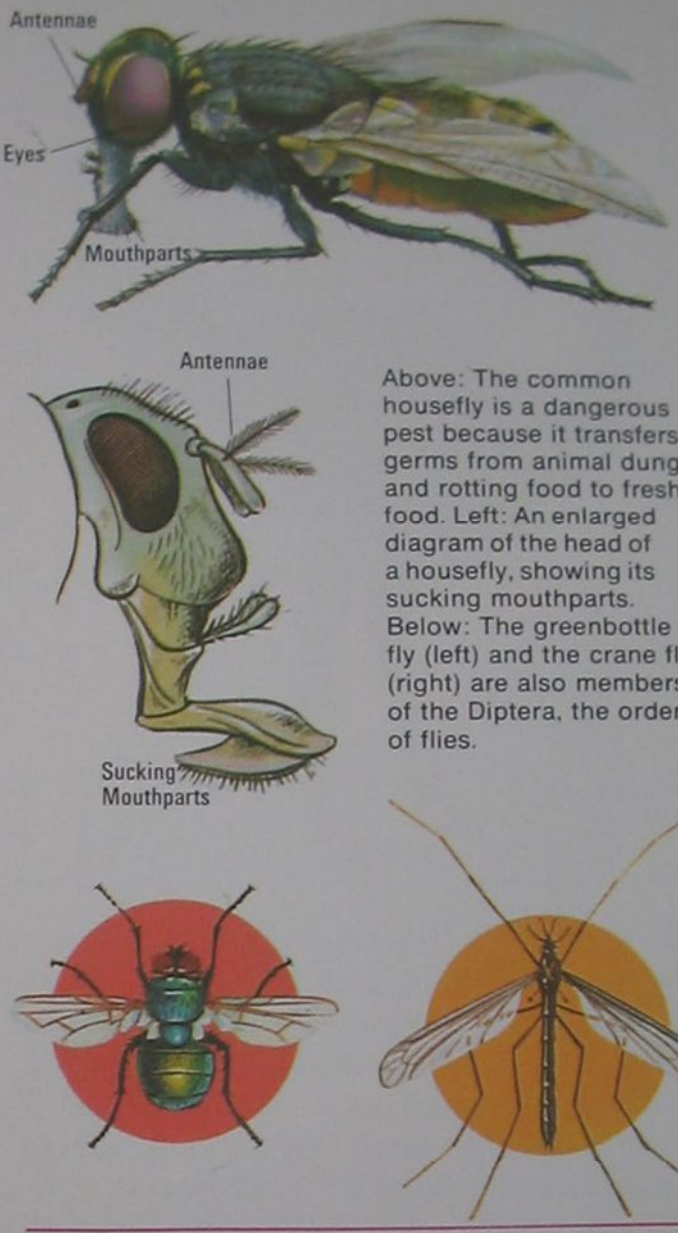
quitoes spread malaria and yellow fever, and tsetse flies spread sleeping sickness. Controlling flies has helped to reduce the spread of such diseases as dysentery, cholera and typhoid.

Flies are also dangerous to animals. Hornflies may settle in swarms on cattle and suck their blood, affecting their weight and milk supply. Sheep keds are wingless flies living in the wool of sheep, sucking their blood. Some flies lay their eggs on live animals. Screw-worm flies lay eggs in wounds in the skin of cattle and other animals. The maggots grow and eat into the wound, seriously harming the animal.

Some flies harm plants and crops. Hessian flies cause great damage to wheat crops, and fruit flies eat great amounts of fruit.

The most familiar fly to man is the housefly. The female housefly lays her eggs in manure or rotting vegetable matter. Tiny white maggots hatch a day or two later and start to grow. As they grow, they shed their skins and develop new ones twice. After about a week, the skin hardens into a case and the maggot inside changes into a fly. This process, called *pupation*, takes a few days in summer. When the adult fly emerges from its case, it crawls about for a short time to dry and then flies away. It does not grow any more. The adult fly lives for about a month, and very rarely survives the winter.

Adult houseflies cannot bite or pierce with their mouthparts, so they cannot eat solid food. Instead, they pour a special digestive juice on to the food to dissolve it, and they suck up the liquid with their mouthparts. In this way, houseflies spread germs picked up on previous visits to animal dung and rotting food.



Above: The common housefly is a dangerous pest because it transfers germs from animal dung and rotting food to fresh food. Left: An enlarged diagram of the head of a housefly, showing its sucking mouthparts. Below: The greenbottle fly (left) and the crane fly (right) are also members of the Diptera, the order of flies.

Flightless birds Birds are descended from reptiles. The front legs of the ancestral reptiles gradually evolved into wings and the birds developed the ability to fly. Flight was useful because it meant the birds could reach new surroundings, escape from their enemies, and avoid competition with the ground-living mammals. In areas where there were few mammals to compete with them, some birds soon abandoned flying and started to live on the ground again. They gradually lost the ability to fly and they became the flightless birds—the ostriches, kiwis, cassowaries, emus and rheas. These all have useless wings and strong running legs. They are generally regarded as rather primitive birds. Penguins are also flightless, but they belong to a different group. Their wings are far from useless, being used as paddles for rapid underwater swimming.

The ostrich is the largest of all living birds. An adult male is about eight feet

Below: The ostrich is the largest living bird and grows to a height of up to 8 feet. Ostriches are found in Africa.
Right: The kiwi is a flightless bird of New Zealand. It is about the size of a large chicken.

tall. Ostriches live in Africa and once ranged the whole continent. Now they are nearly all confined to national parks where they are protected. The ostrich is a shy bird. As soon as it is disturbed, it races away. Its great speed helps it to escape from animals that would eat it.

Rheas are sometimes called South American ostriches. They look rather like ostriches but are only about five feet tall. They are the largest American birds.

Cassowaries live in Australia and on some of the islands to the north of it. They are bad-tempered birds that attack feet first and slash at their enemies with their sharp claws. Emus are also Australian birds.

The kiwi lives in New Zealand. It is a dumpy bird, about the size of a large chicken. It lives in swampy forests and is difficult to find because it is nocturnal (active at night) and very shy. The kiwi's nostrils are at the tip of the long beak and this helps it to smell out the grubs that it eats. Most other birds find food by sight.

Flinders, Matthew (1774-1814), was a British naval captain and explorer. In 1794, he sailed for New South Wales. On the journey he met the British explorer George Bass. When the two men reached Australia, they began a series of explorations that lasted until 1799. During these explorations they sailed right round Van Diemen's Land (now Tasmania), thus proving that it was an island.

In 1800, Flinders returned to Britain and was given command of the *Investigator*. He sailed for Australia again in 1801, where he charted the Gulf of Carpentaria, and completed a journey right round Australia.

On his way back to Britain in 1803, unaware that Britain and France were then at war, Flinders stopped at the French island of Mauritius. He was imprisoned for eight years as a spy. An account of his adventures, *Voyage to Terra Australis*, was published on the day of his death.

Flintshire, located in North Wales and bordering the Dee estuary and the Irish Sea, is the smallest of the Welsh counties. It includes a small detached area east of Denbighshire. Its county town is Mold, and its population is 175,400.

The chief rivers are the Dee and the Clwyd. Oats and wheat are grown in the many beautiful valleys, and dairy cattle, pigs and poultry are reared. Coal is mined in the north of the county, and there are also a few lead and zinc mines. Other

towns besides the county town are Flint, which has large rayon factories; the resorts of Rhyll and Prestatyn; and Holywell.

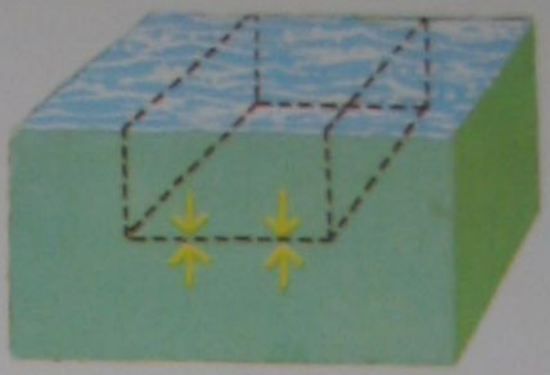
Floating An object floats if it is less dense than the liquid it is in (the density of an object is its mass divided by its volume). Wood floats on water because it is less dense than water. People float easily in the Dead Sea because the very salty water is denser than a human being. For the same reason, oil 'floats' on water and a balloon 'floats' in the air.

The first man to study floating scientifically was the Greek mathematician Archimedes. According to legend, he pondered the problem while sitting in his bath. He noticed that when he got in the bath, the water level rose. He realized that when an object sinks in water, it displaces its own volume of water. Furthermore, a floating object must have acting on it an upward force which stops it from sinking. This force, called *upthrust*, equals the weight of water displaced. There is upthrust acting even on an object which sinks; that is why objects weigh less in water than they do in air. It is said that when Archimedes made his discovery, he jumped from the bath and ran down the street naked shouting 'Eureka' which means 'I have found it'.

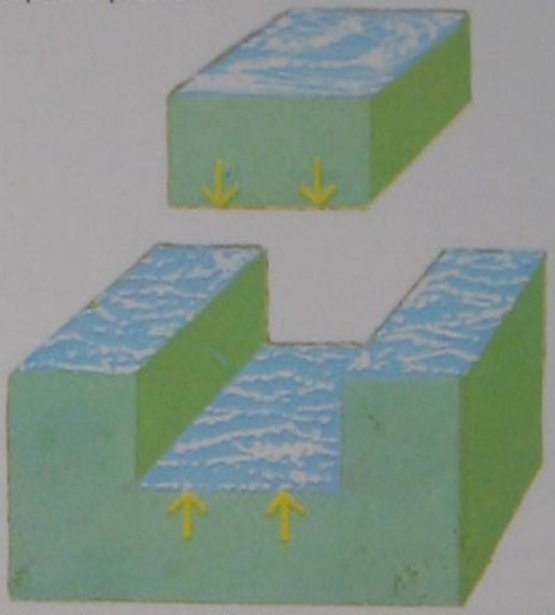
Floods may occur when heavy rain or melting snow causes river channels to fill until they overflow or burst their banks. Rivers sometimes change their course and torrents may destroy entire villages. For example, the Hwang Ho of northern China has flooded more than 1,500 times in 3,000 years, drowning millions.

The sea also causes floods. In the Netherlands, parts of which lie below sea-level, ferocious storms may direct great waves at the coast. Such waves have sometimes smashed through the coastal walls and huge areas have been flooded.

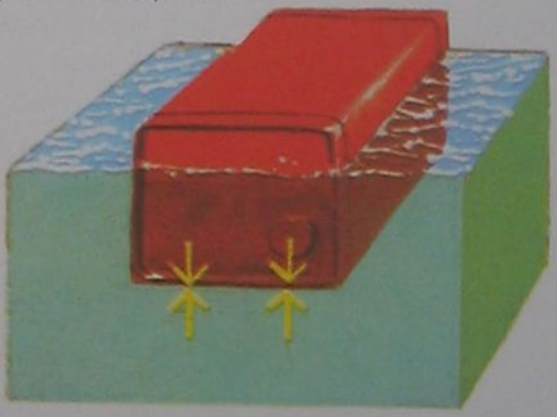
River floods are not entirely destructive. For thousands of years, the Nile



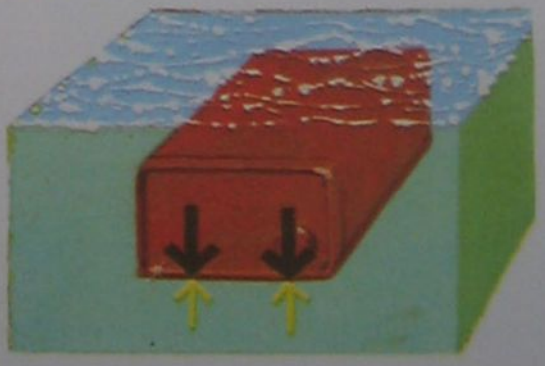
A 'block' of water floats because its weight is balanced by an upward pressure.



If the 'block' is removed, the upward pressure will support an object of the same weight, such as an empty but closed petrol can.



If the can is filled with water, the pressure will not support the weight of the can plus the water inside, and the full can will sink.



British troops help to rescue women and children from a flooded street in Belfast, Northern Ireland. Floods not only cause considerable damage to homes but can also play havoc with electricity and drainage services.

in Egypt regularly flooded its valley and delta. The muddy water spread fertile silt over the land. As a result, the Nile valley has rich soil. Plains crossed by rivers, which sometimes flood, are called *flood plains*.

Flooding is common in regions which have been stripped of grass and forest. Trees are often planted to prevent floods, because forest soil absorbs rainwater.

Florence (pop. 460,100) is a city of Tuscany, Italy. It is situated on the banks of the River Arno on the foothills of the Apennines. The city was founded in Etruscan days, flourished under the Medici and is, as then, a centre of intellectual and artistic life. It is rich in art and architectural treasures, the Uffizi Galleries and the Pitti Palace containing some of the world's most famous paintings and sculptures. Florence Cathedral, the Duomo of St Maria del Fiore, has multicoloured marble facing and an immense dome. In 1966 the river Arno burst its banks and two-thirds of the city were flooded. Many famous works of art were lost or damaged.

Florida is the south-easternmost state in the United States. About half its income comes from tourism. Beautiful beaches and a warm, sunny climate bring many visitors to Miami Beach and other famous resorts. Other attractions include the Everglades, a tropical marshland with many exotic plants and animals. Most of the state consists of a 400-mile-long peninsula, between the Atlantic and the Gulf of Mexico. Its area is 58,450 sq. miles.

Agriculture, fishing, manufacturing and mining provide other sources of income. Florida produces more than three-quarters of the country's citrus fruits. The state manufactures processed foods, wood products and chemicals, and mines phosphates for fertilizers and explosives.

Location map of Florida.

Florida has more than 6,670,000 people and its population is growing rapidly. Some of the inhabitants are elderly people who have moved to Florida for retirement. Most of the land is low and flat. There are more than 30,000 lakes in the peninsula, and many kinds of forests. A chain of islands, called the Florida Keys, extends south-westwards from the peninsula tip. The Overseas Highway runs for 130 miles from the mainland to Key West, the end point of the Keys. The state capital is Tallahassee and the largest city is Jacksonville. Cape Kennedy, on the eastern coast, is the site of the John F. Kennedy Space Center.

The Spanish explorer Juan Ponce de León reached Florida in 1513 while looking for the legendary Fountain of Youth. Florida became a United States territory in 1821 and a state in 1845.

Flower The flower is the reproductive part of flowering plants, or *angiosperms*. It is the region where the male and female sex organs occur, where the pollen is produced, and where the seeds grow.

Flowers come in all shapes and sizes, but there is a basic pattern. Inside a flower there is a slender central column, usually forked at the top. This column is the *style* and the forked part is the

The Ponte Vecchio, with its tiny shops, crosses the River Arno in Florence

stigma. The lower end of the style is attached to the *ovary* and the whole arrangement forms the *pistil*, which is the female part of the flower. The ovary contains the *carpels*, which later become the fruit, and each carpel contains the *ovules*, which later become seeds.

Around the style you will see a number of stalks, each with a little pouch, or *anther*, at the tip. These are the *stamens*—the male parts of the flower—and the pouches contain pollen grains. When pollen falls on a ripe stigma, the flower is said to be pollinated. Fertilization of the ovules follows and seeds are formed.

Carpels and stamens are both necessary for seed production and these organs are often called the *essential parts* of the flower. The majority of flowers contain both stamens and carpels and, being both male and female, they are said to be *hermaphrodite*. Many plants, however, do have flowers of separate sexes—flowers with either stamens or carpels but not both. The marrow is a well known example. The number and arrangement of the essential parts varies a great deal. Some flowers have only one carpel; others have many. If there are many carpels, they may all be separate, as in buttercups, or they may be joined together, as in poppies. Stigmas are always present, but they are not always raised up on a style.

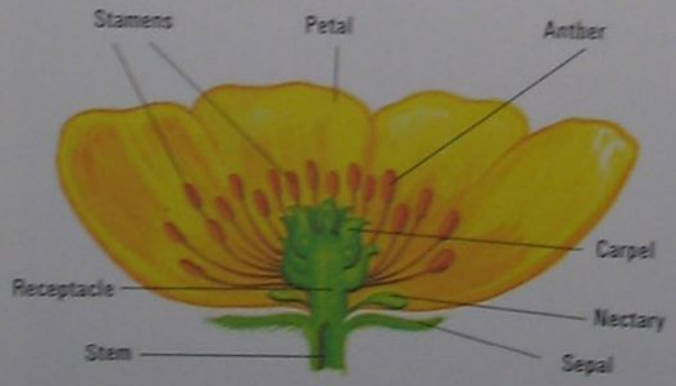
Some simple flowers contain only the essential parts, but the deadnettle and most other flowers surround the carpels and stamens with *petals*. These are the most conspicuous parts of the flower and, as a rule, flowers that rely on insects to distribute their pollen are brightly coloured. In addition, insect pollinated flowers often have scent and nectar which attract the insects.

The largest flower in the world grows from the unpleasantly named Stinking Corpse Lily that grows in south-east Asia. The mottled brown and white flowers grow as large as three feet across and can weigh up to 15 pounds. It is also called Giant Raflesia. Some flowers are edible. The Japanese drink Cherry Blossom soup which is made from pickled Cherry Blossom.

Flower petals present a bewildering array of shapes and arrangements and are one of the main features which a botanist uses to group flowers into families. The whole group of petals in a flower is usually called the *corolla*.

Around the outside of the petals of a typical flower is a ring of small greenish, leaf-like structures. These are called the *sepals*, and together they make up the *calyx*. Many narrow-leaved plants (Monocotyledons), such as the bluebell, have sepals that look just like the petals. In a few flowers, the marsh marigold for example, there are no petals and the sepals are brightly coloured.

Flowers develop singly or in clusters depending on the species of flowering plant. A plant's flowers are called its *inflorescence*. An inflorescence is one of



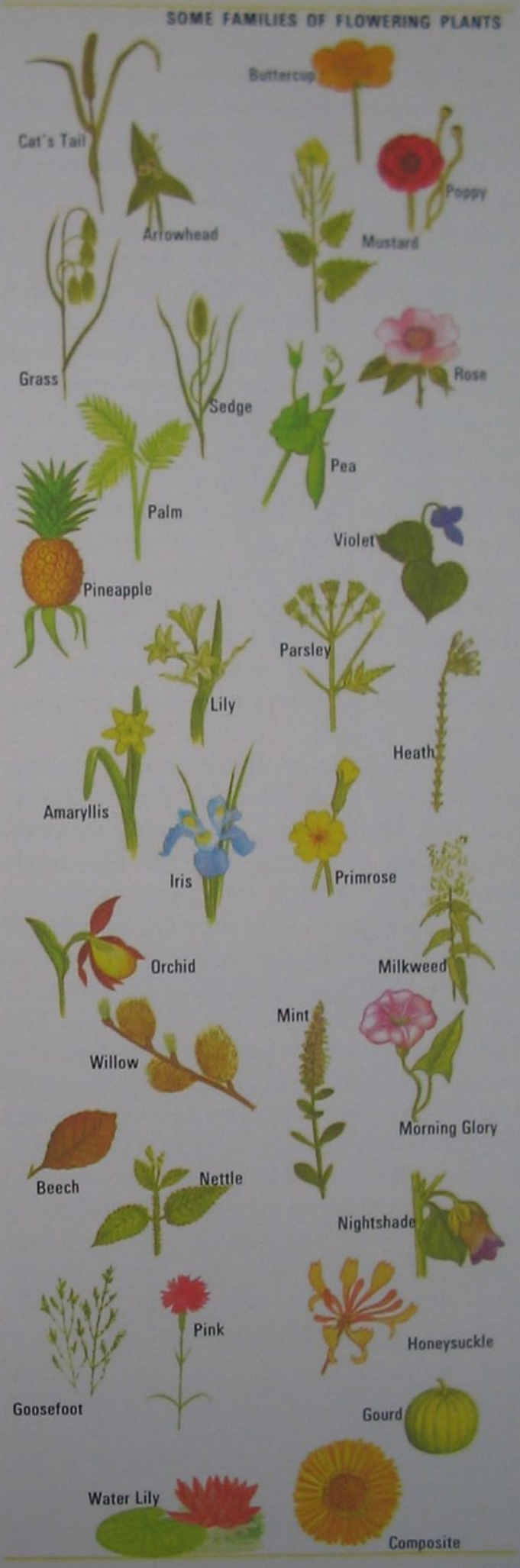
Above: A cross-section of a buttercup flower showing the parts of a typical flower. Right: The stichwort has a cymose inflorescence. Far right: The bluebell has a one-sided racemose inflorescence.

two kinds: *racemose* or *cymose*. The flowering shoot of a raceme gives off lateral (side) shoots which bear flowers, but the main shoot itself does not end in a flower. The flowers in a raceme open from below upwards, and as such differ from those in a cyme, which open in the opposite order. Each flowering shoot of a cyme produces a flower at its tip before those on lateral branches below. Cymose inflorescences occur in buttercups, poppies, and stitchworts, amongst others, while racemose inflorescences are found in lupins, plantains, bluebells, candytuft, and cowslips.

Flowering plants are the most successful members of the plant kingdom. There are far more kinds of flowering plants than there are species of any other group in the plant kingdom.

Flowering plants, or more correctly *angiosperms*, have well-defined roots, stems and leaves. They produce flowers, and develop seeds enclosed within protective envelopes, or fruits. About 250,000 kinds of flowering plants belonging to 300 families have been described. They grow almost anywhere. Most of them are terrestrial species. Some, such as enchanter's nightshade, can flourish in the gloomiest forests; others are equally at home on sun-drenched alpine slopes. Several kinds live in water, either attached to the bottom of a pond or riverbed, or simply floating freely on the surface. Some kinds, such as tropical orchids, grow on trees with their roots dangling in the air, and others, like cacti, can make their homes in arid, inhospitable deserts. Even brackish and salty marshes have their flowering plants, while bogs, fens, woodlands and meadows abound with them.

The life-story of a typical flowering plant begins with a seed. At the start of the growing season the weather turns warm. The seed sprouts, thrusting out roots into the soil and shoots into the air, using the food reserves tucked inside the seed coat. The new green leaves start mak-



ing food, and storing away what the plant does not use immediately – it will soon be needed. When the plant is well established, vegetative growth of leaves and stems slows, and flowers develop.

Flowers must be pollinated. Plants rely mainly on wind or insects for this (see Pollination). You can tell which flowers are normally pollinated by insects. The blooms are colourful, scented, and often contain nectar. Wind-pollinated plants, on the other hand, generally have drab flowers with lots of pollen borne in anthers dangling on long filaments that stick out into the air. No colour, scent, or nectar here – they cannot bribe the wind. Once pollinated and fertilized, the flower develops its seeds, and the fruit swells up around them. Food stored by the plant is poured into each seed, giving each a 'survival pack' for its first few critical days of life. The fruits help to scatter the seeds so that they do not all try to grow in the same place (see Seeds).

Flowering plants show almost endless variations on their life-cycle theme. Some, such as groundsel and many other successful weeds, complete several life-cycles from seed to seed in one growing season. This is one reason why they are so difficult to get rid of in the garden. Others, such as mulleins and Canterbury bells, normally take two years to produce their seeds. The first year is spent building up food reserves. Still others, such as stinging nettles and dog's mercury, die only above the ground when autumn comes. Their roots, packed with stored food, provide nourishment for renewed growth the following spring. These *perennials*, as they are called, are very numerous. Some perennials are so hardy they do not even die down in the winter. Dandelions and many grasses remain green and above ground all the year.

The Giant Chinese Wisteria is the world's largest flowering plant. A specimen planted in California in 1892 covers almost an acre of ground and produces about one and a half million blossoms. Fossil remains have been found of flowering plants of the palm variety which are about 165 million years old. The smallest flowering plant is the duckweed which is 0.002 inches.

Flowering plants belong to one of two great classes, *monocotyledons* or *dicotyledons*, according to whether their seeds possess one or two seed leaves respectively. There are other differences too. Monocotyledons are almost all herbs (non-woody plants), they have leaves with parallel veins, stem-veins scattered throughout the stem, and flower-parts (stamens, carpels, petals and sepals) in threes or multiples of three. Dicotyledons contain many woody species. Their leaves are generally net-veined, and the stem veins occur in a definite cylinder down the stem. Their flower parts are generally found in fours and fives.

Here are a few facts to help you decide which flowering plant family a flower belongs to. Grasses *(Gramineae)* are monocotyledons with long, strap-shaped leaves and hollow stems. Their flowers are green and not very obvious. When the flowers are ripe, the yellow anthers hang out in the wind so that their pollen will blow away. Cereal grasses are mankind's most important food crops.

The rose family *(Rosaceae)* consists of herbs, shrubs and trees. Their flowers usually have five similarly shaped, separate petals, five sepals, and a large number of stamens and carpels. Cultivated roses have fewer stamens and more petals. Apples, plums, strawberries and blackberries belong to the rose family.

The pea family *(Leguminosae)* usually have compound leaves, with two rows of little leaflets growing from a central leaf stalk. The leaves often have tendrils which help the plants climb. The flowers have five petals and are all of a similar shape, with a large *standard* petal at the back. The fruits are pods. Vetches, broom, clover, peas and beans all belong to this family.

The parsley family *(Umbelliferae)* is characterized by its *inflorescence*, or flower-head, which is called an *umbel*. The main flowering stem stops growing

and a number of smaller flower-bearing stalks grow out from its tip. The flowers are tiny and are generally white or yellow. The stems are hollow and often ribbed.

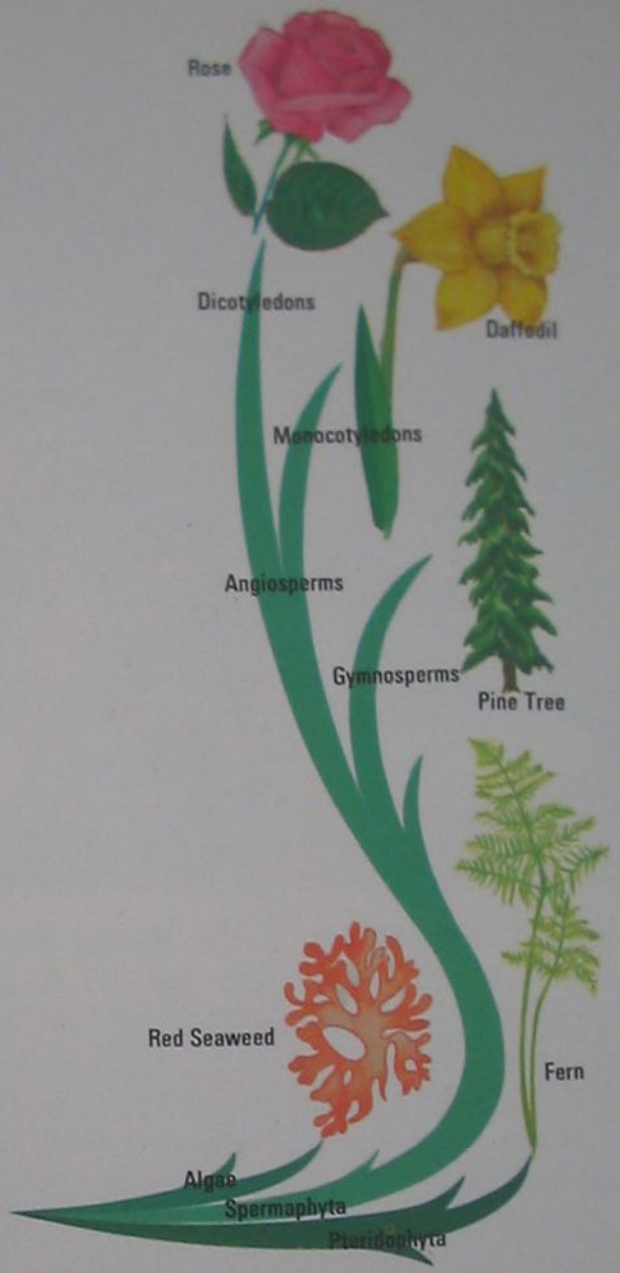
The daisy family *(Compositae)* have their tiny flowers packed together in dense heads or clusters. What is usually called the flower is really a collection of small flowers, or *florets*, grouped together. The flowers later develop parachutes of hairs that carry the fruits away on the wind.

The wallflower family *(Cruciferae)* is quite easy to recognise because the flowers have four petals. There are six stamens as a rule, four long and two short. As well as wallflowers this family includes cabbages, mustard, watercress and candytuft.

Fluoridation is the addition of small amounts of fluorine compounds to drinking water to prevent tooth decay. The value of fluorides in strengthening tooth enamel was discovered by an American public health dentist in the 1930's. He found that children in certain areas had far fewer cavities than normal, and traced this to natural fluorides in the water.

In 1945, Grand Rapids in the United States became the first city to fluoridate its water. Since then, many other cities have done so, including cities in Australia, Canada and the United Kingdom. The chemicals usually added are sodium fluoride and sodium fluorosilicate. Some people object to the fluoridation of water, because they do not think enough research has been carried out, or because they feel that it infringes their rights.

Flying Doctor service is a means of providing medical services for people living in isolated or inaccessible areas such as the Australian outback and areas of Kenya. In such places, it is not possible to have local doctors or hospitals. And even if medical facilities were provided at central points, patients would not be able to reach them because of poor roads and the lack of telephones.



Flowering plants belong to the angiosperm group of plants. There are two classes of flowering plants, monocotyledons and dicotyledons. The other major groups of plants are the gymnosperms, including coniferous trees, the algae, including seaweeds, and the pteridophytes, including ferns.

The Royal Flying Doctor Service of Australia is the oldest and largest such service. It operates from 12 base stations —one each in New South Wales, Northern Territory, and South Australia, three in Queensland, and six in Western Australia. When help is needed, the doctor is contacted by means of two-way radio sets that people keep in their homes. The caller describes the injuries or illness and the doctor decides whether a visit is necessary. If so, he goes by aeroplane

N.J.E.—7-B

A flying doctor treats a patient in the back of his aircraft. It is equipped as a surgery and the doctor can treat many cases there. Others are flown to the base hospital.

to attend the patient. If the doctor feels that it is necessary for the patient to go to hospital, the plane acts as an air ambulance.

If a patient's illness is not serious, the doctor may not have to make a trip. Instead he gives instructions over the radio for home treatment using medicines, bandages and other standard equipment kept on hand in a special kit. Flying doctors also make routine visits throughout their areas to vaccinate children and carry out other public health measures. The flying doctor service is free. Its upkeep is paid for by state funds and voluntary contributions.

The flying doctor idea was thought up by a Presbyterian missionary doctor and an engineer. When the service (then called the Australian Inland Mission Aerial Medical Service) began in 1928, pedal-driven dynamos powered the radios, and messages had to be sent in Morse code. The use of transcribing typewriters overcame this drawback, and the idea spread rapidly.

From a few hundred visits in the first year, the service today handles several thousand visits a year and many more radio consultations. The service has also helped people by providing communication links in areas where none existed previously; at certain times of day people can talk to each other over their radios, and a 'school of the air' is held from the Alice Springs base.

Similar flying doctor services began in parts of Africa in the 1960's. Canada's air ambulances have operated since 1947. Even in the United States, where few areas are cut off from medical services, doctors are finding that helicopters can be used to speed emergency service and save lives.

Fog is simply cloud that forms just above the ground. When warm, moist air passes over a cold surface, the moisture in the

air is cooled below the *dew point* (the temperature at which it begins to condense). As it condenses, it forms millions of tiny water droplets, which are seen as fog. (See Condensation.)

There are two chief kinds of fog: *advection* fog and *radiation* fog. Advection fog forms when warm air blows across cold areas of land or water. The air is chilled and the moisture in it condenses. This type of fog is common in the English Channel and on the Atlantic coast of Canada. Radiation fog occurs, often on clear winter nights, when the warmth from the ground escapes quickly by radiation into the upper air. As a result, air near the ground is chilled.

Weathermen grade fog by visibility tests. They say that a 'fog' exists if objects cannot be seen at a distance of 1 kilometre (five-eighths of a mile). A 'thick fog' means that there is visibility of less than 200 metres (220 yards); and a 'dense fog' means that visibility is less than 50 metres (55 yards). Ground cloud with visibility more than 1 kilometre is graded as *mist*.

Food is necessary for life. It provides energy for movement and warmth, and it helps our bodies grow and keep healthy. Some small animals will die if they are without food for more than a few hours. Larger creatures can store enough food in their bodies to survive for days or weeks without eating. A man can survive for about seven to eight weeks without food, so long as he has a supply of water.

There are thousands of different kinds of foods, but they are all made of a few basic kinds of chemical 'building blocks' called *nutrients*. The three main nutrients are *carbohydrates*, *fats* and *proteins*. We also need *minerals*, such as calcium and iron, and *vitamins*. A 'balanced diet', necessary for good health and growth, must include enough of all these groups.

Sugar and starch are important carbohydrates. Bread, rice, sweets and cakes

Several flavours are often mixed together in cooking food, which help to make it appetizing.

provide much carbohydrate. It supplies the body's 'fuel' for movement, work, and keeping warm. Fats are also good fuel, in a more concentrated form. But the body can use sugar much quicker than fat. Cream, butter and fat meat are good fat-containing foods. Excess fats and carbohydrates are stored in the body, making us fat.

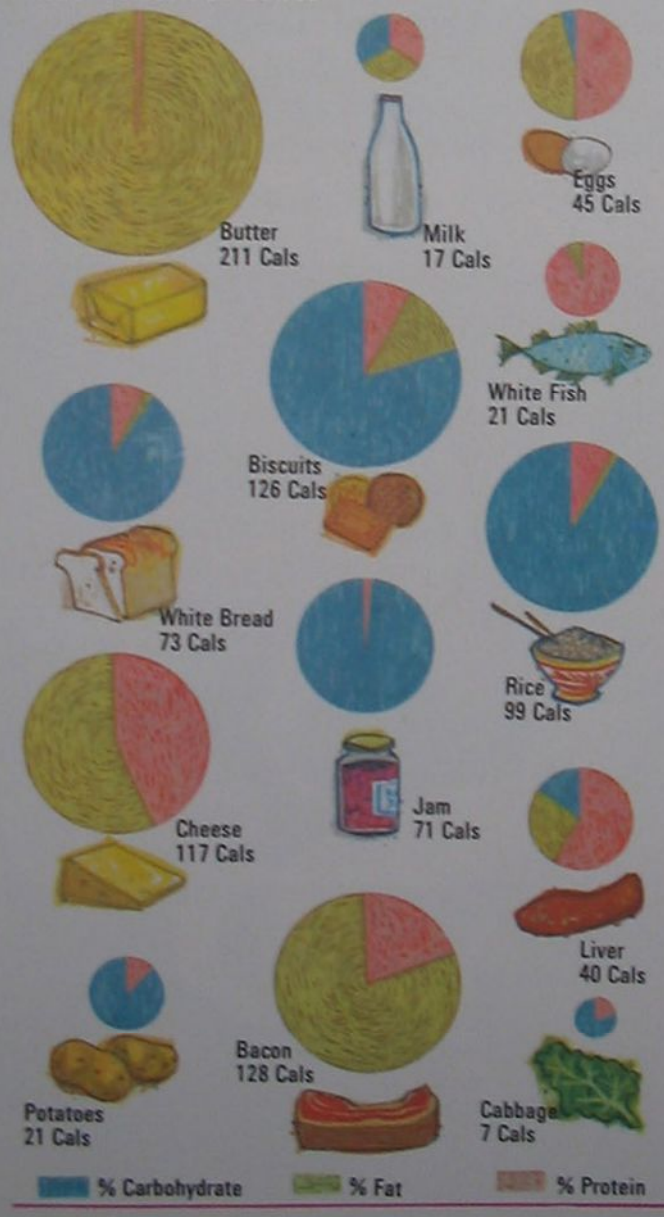
Protein is essential for growth and health, because it forms the main part of the body's cells. It can be burned to produce energy, but its body building and repairing function is much more important. Protein-rich foods include lean meat, fish, eggs, milk, cheese and beans.

Vitamins are complicated substances needed in small quantities to make sure the body's chemical processes continue normally (see Vitamins). Minerals are also needed by the body. Among other things, they help to make good bones, teeth and blood.

Many people in poor countries in Africa and Asia either do not get enough food or else can only get food which lacks the right amounts of vitamins and proteins. Scientists fear that, if the world population increases too much, this problem will affect the whole world. They are continually trying to find ways to increase the world's food supply. Better types of cereal crops which give more food, are more resistant to disease and which grow more quickly have been bred. The introduction of factory farming has greatly increased the supply of fresh meat and poultry.

The sea is a major source of food and over 35 million tons of fish are landed every year. But there are signs that if we continue to take fish from the sea at this rate, the supply will eventually run out. For example, the great shoals of herrings which used to be in the North Sea had almost disappeared completely by 1972. To prevent this happening, scientists are studying methods of 'farming' fish so that we may replace what we eat and not exhaust this valuable supply of food.

CALORIFIC VALUES OF COMMON FOODS IN KILOCALORIES PER OUNCE



Talking points

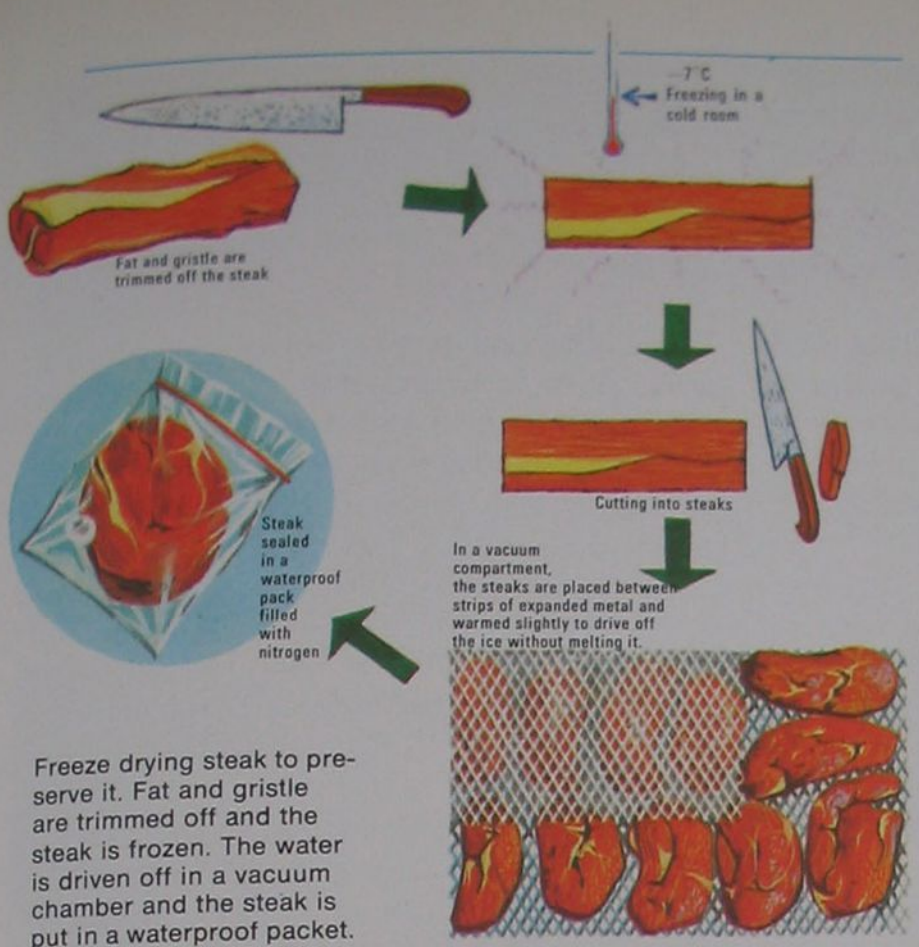
* Carbohydrates, fats and proteins are all essential parts of our diet. When you sit down to a meal, make a note of what you have eaten and, afterwards, find out whether it was 'deficient' in any way.
* Food is the 'fuel' that keeps the complicated systems in the body working properly. What are the main ways in which it does this?
* Some people fear that if the population of the world continues to grow at its present rate, there will soon be not enough food to go round. Have you any idea for increasing world food production?

Articles to read

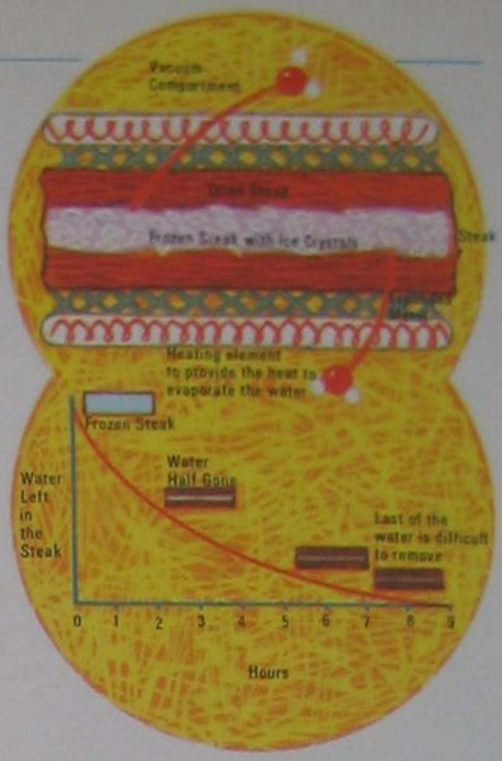
Diet; Digestion; Food preservation; Famine.

Food preservation Most food will not keep fresh for very long if left by itself. Fish and meat will quickly go bad and start to smell. Fruit and vegetables will soon rot. This *spoilage* is caused by chemical changes in the food or by the growth of very tiny organisms.

Micro-organisms such as yeasts, moulds


-7°C
Freezing in a cold room
Fat and gristle are trimmed off the steak
Cutting into steaks
In a vacuum compartment, the steaks are placed between strips of expanded metal and warmed slightly to drive off the ice without melting it.
Steak sealed in a waterproof pack filled with nitrogen

Freeze drying steak to preserve it. Fat and gristle are trimmed off and the steak is frozen. The water is driven off in a vacuum chamber and the steak is put in a waterproof packet.


Vacuum Compartment
Steak
Frozen Steak with Ice Crystals
Heating element to provide the heat to evaporate the water
Frozen Steak
Water Left in the Steak
Water Half Gone
Last of the water is difficult to remove
0 1 2 3 4 5 6 7 8 9
Hours

The steak is given enough heat to evaporate the ice without melting it or burning the outer layers of dried steak. It takes about 8 hours to complete the drying. Water is driven off quickly at first, then more slowly.

and bacteria are in the air all around us, and they may grow on all kinds of foods. Many of these organisms cause food to ferment and turn sour, to give off smelly gases. Some bacteria produce substances which give people food poisoning.

To preserve foods we must somehow prevent all these things from taking place, or at least slow them down.

Canning is the most important method of food preservation, and it can be used for practically all kinds of foods. In canning, the food is sealed in airtight cans and heated strongly. Any organisms present are killed by the heat. No more can get in because the can is sealed.

The 'tin' cans which manufacturers use for canning are made automatically from sheets of tinplate (sheet steel coated with tin). Filling and sealing the cans are also usually done automatically.

Bottling is generally used for fruit and vegetables. It is similar to canning, but the food is packed in bottles instead of cans. Many housewives do their own bottling at home.

Freezing can be used to preserve most foods—even pre-cooked meals. Organisms cannot grow and chemical changes are halted at low temperatures. The food has to be frozen very quickly, otherwise the texture and flavour of the food are harmed. Most foods are packaged in paper or plastic before they are frozen to prevent them from drying out during storage.

Refrigeration is used to keep food fresh at low temperatures. The food is kept in huge rooms which are really large-scale versions of the domestic refrigerator. But the temperature is generally kept way below freezing point throughout. In most domestic refrigerators only the freezing compartment is kept below freezing point. Refrigeration has made possible the large-scale transportation of fresh meat from country to country.

Drying, or *dehydration*, is one of the oldest ways of preserving food. Organisms cannot grow on dry food. Many foods, especially fruits, are still dried in the sun. Currants, sultanas, and raisins, for

example, are sun-dried grapes. But many foods are now dried in heated kilns or in special dehydrators. One of the latest methods of preservation is *accelerated freeze drying* in which the foods are rapidly dehydrated in a below-freezing vacuum.

Curing methods, such as salting and smoking, are widely used to preserve meat and fish. Bacon and kippers are well-known salted and smoked products. Sugar (in jams) and vinegar (in pickles) are other common preserving agents.

Football A number of team ball games played in various parts of the world are called football. These include association football, rugby football, American football, Gaelic football and Australian rules. By far the most widely played of the football games is *association football*, popularly known as 'soccer'. Soccer was born in Britain, but it is popular in many parts of the world, particularly in Europe and South America.

Soccer is played by two teams of 11 players, on a rectangular pitch 100 to 130 yards long and 50 to 100 yards wide. It is played with a round leather ball. A game lasts for 90 minutes, with an interval at half-time.

At each end of the pitch, at the centre of the goal-line, is the goal—a crossbar supported by goalposts. A team scores a goal when the ball passes through the opposing side's goal. Players may use their feet, head or any other part of their body except their arms and hands to propel the ball. One player on each side, however, may handle the ball when it is in play—the goalkeeper. But he can do so only in his side's penalty area, a 44 by 18 yards rectangle in front of the goal. The game is controlled by a referee, who is aided by two linesmen.

There are various kinds of offences in soccer, including handling the ball, tripping, obstruction and violent play. Such infringements are punishable by the award of a free-kick to the opposing side.

The game of rugby originated at Rugby school in 1823. According to legend a game of soccer was in progress when one of the players, William Webb Ellis, picked up the ball and ran with it, instead of kicking it. Rugby is no longer confined to the English speaking world but is played in such places as Rumania and Japan.

When the ball passes out of the playing area, it is returned into play by means of a throw-in, goal-kick or corner-kick.

Soccer emerged as an organized sport in England in the mid-1800's. The world governing body for soccer is FIFA (Fédération Internationale de Football Association). It was formed in 1904, and by the early 1970's had 140 member countries. The major world tournament is the FIFA World Cup, held every four years.

Rugby football grew out of the football game played at Rugby School in the 1820's. In rugby, the emphasis is more on handling than kicking the oval-shaped ball. There are two distinct codes—rugby union, a 15-a-side game, and rugby league, 13-a-side. The two kinds are played chiefly in Britain, Australia, New Zealand, South Africa (rugby union only), Ireland and France.

Rugby union, which developed from a breakaway movement in soccer, is an entirely amateur game. It is played on a rectangular pitch, with a maximum width of 75 yards. The 'H'-shaped goals are situated on the goal-lines, which are a maximum 110 yards apart. Behind the goal lines the pitch extends for not more than another 25 yards, marking the 'in-goal' area. A game lasts for 80 minutes, with an interval at half-time.

The ball may be kicked, carried or thrown, but may not be thrown forward. The object of the game is to score points by various methods. A player touching the ball down by hand over the oppo-

Opposite: A lineout in a trial game to select the New Zealand team (the 'All Blacks') to tour South Africa in 1970. The All Blacks have been one of the most successful rugby sides for many years.

2

Football is one of the most popular sports in the world. The picture above shows two teams competing in the World Cup, which takes place every four years.

nents' goal-line scores a 'try'. This entitles the scoring side to kick at goal. A try is worth 4 points; if the try is successfully 'converted', that is, if the ball is kicked over the crossbar and between the posts, it counts a further 2 points. Points may also be scored by a drop-kick (3) or penalty kick (3) over the crossbar.

After minor infringements of the rules, such as throwing the ball forward or off-side, play is restarted with a scrum, or scrummage. Usually eight men from each side link in formation and face each other, the players of the front rows pressing shoulder against shoulder. The ball is put through the 'tunnel' between the two sets of players, and they attempt to heel the ball back to their respective team-mates. Penalty kicks are awarded for certain more serious offences, and are taken from the place where the offence occurred. When the ball goes out of play over the touch lines, play is restarted with a 'lineout'.

International rugby union attracts large crowds. It is the national sport of New Zealand, South Africa and Wales. It is becoming increasingly popular in Argentina, Japan, Fiji, and Rumania.

Rugby league was formed in 1895 by a breakaway group of rugby union clubs in the north of England who wanted to 'compensate' players for their time. It soon developed as a 13-a-side game with some basic differences from the union code. There are no lineouts, the game being restarted with a scrum when the ball goes over the touchlines. When a player is tackled, he does not have to release the ball, but plays it back with his foot to one of his own men. The field of play is similar to that of rugby union, but the points scoring is slightly different.

The main centres of rugby league are England, in the north, and Australia, in New South Wales and Queensland.

Australian rules football is played only in Victoria, South Australia, Western

Australia and Tasmania. It has a strong following in Victoria. It is played on an oval pitch, twice the area of a normal soccer pitch, and there are 18 men a side. The ball is oval and may be punched, palmed or kicked, but not thrown.

Gaelic football, a cross between soccer and Australian rules, is a 15-a-side game played in Ireland. The ball is round, and may be kicked or fisted.

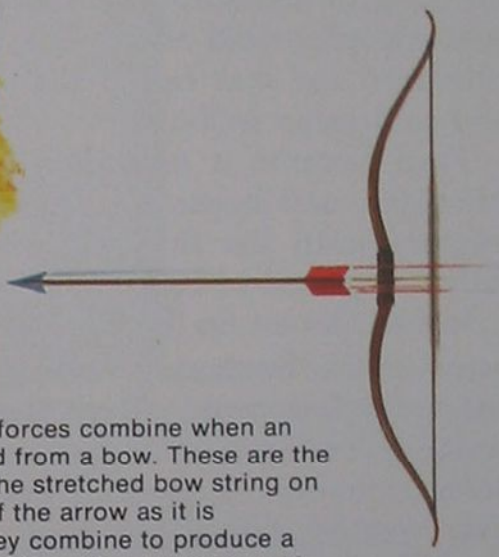
American football resembles the rugby codes and is the national sport of the United States. It is characterized by long forward passes and crunching tackles. Teams consist of 11 players, with almost limitless substitution. A similar game, *Canadian football*, is played in Canada, with 12 players a side.

Forces If you push or pull an object, you exert a force on it and if it is not held tightly, it will move. All forces act to cause a change in motion. But force is not necessary to *keep* an object in motion. Once an arrow is fired from a bow, it keeps moving without more force acting on it. Force is required to keep a motor-car or an aircraft moving at a constant speed, because the friction in the moving parts and of the air around the vehicle act to drag it back and slow it down. When the force of the engine driving it forwards is equal to the friction dragging it back, the vehicle moves at a constant speed. But if the engine power is increased, the vehicle's speed will increase until the friction again equals this power. Thus, if a force acts on an object, it produces an acceleration. If no force acts on it, it will remain at rest or continue to move at a constant speed in a straight line. This law of motion is best seen in a space-ship outside the Earth's force of gravity. When the motors fire, the space-ship accelerates. Immediately they stop, the ship coasts on at the speed it has reached, as there is no air in space to cause friction and slow it down.

A space-ship's rocket motors work by

Left: A spaceship moves by reaction. Burning fuel streams from the rocket's engines with great force, but an equal force in the opposite direction, the reaction, pushes it forward.

Above: A magnet exerts a force on iron nails when it attracts them. Magnetic force is one of the forces in nature that acts over a distance.



Above: Two forces combine when an arrow is fired from a bow. These are the tensions in the stretched bow string on either side of the arrow as it is released. They combine to produce a single force driving the arrow forward.

reaction. The burning fuel streams out of the exhaust at the back of the ship with great force. But every force produces an equal force in the opposite direction, called the reaction, and it is this reaction force that drives the space-ship forwards. A jet engine works in the same way.

Forces can combine to produce a single force. When an arrow is fired from a bow, two forces act on it. These forces are the tensions in the bow string on either side of the arrow. As the arrow is released, they combine to form one force driving it forward. An understanding of the ways in which forces combine is very

important in building bridges and other large structures.

Forces in nature can act on objects at a distance. The force of gravity acts over vast distances, keeping planets in orbit around the Sun. Electric and magnetic forces act over smaller distances, but are strong enough to overcome the force of gravity. For instance a magnet will lift up an iron nail against the force of gravity. Stronger forces hold the atoms and molecules together in all solid substances, and the forces holding together the particles that make up atoms are even stronger still.

Ford, Henry (1863-1947), was an American engineer and car manufacturer. He was the first to mass-produce cars at a price most people could afford. His first mass-produced car was called the 'Model T', and sold many millions.

Ford became a machinist in Detroit, Michigan, and began to experiment with engines until his first car was successfully completed in 1896.

In 1903 he set up the Ford Motor Company, at the beginning making cars that only very few could afford. However, he really considered that cars should be made available at suitable prices for all who wanted them. He then began to produce the 'Model T', which was soon to benefit all who took part in its manufacture. Ford reduced the working hours of his men and also increased their wages. He put back into the company much of the profits. This displeased the other stockholders, so he bought them out and his family retained complete charge of the business until 1956.

When the United States entered World War I, Ford set his factories to helping the war effort, although he was a confirmed pacifist. During World War II he built the largest aircraft factory in the world.

Gradually, Ford left the running of the company to his son Edsel, and later his grandson Henry Ford II. He devoted much of his time to setting up museums of historic and scientific interest. Ford also set up the Ford Foundation, which gives away millions of dollars every year to advance educational progress and improve living conditions all over the world.

Mr and Mrs Henry Ford sitting in the first Ford car; the car was built in 1896 and tried out in Detroit.

Forestry is the practice of caring for forests so that they continue to produce useful trees. Foresters maintain the quality of the trees in a number of ways. They plant and care for young trees and select trees for felling. They survey and map forests. They keep a watch on the forest and its users, and they help to fight any fires that may break out. Most forests belong to governments or private timber companies, and are fenced off to prevent animals such as deer and rabbits entering and destroying young trees. The law also prevents people from taking away timber.

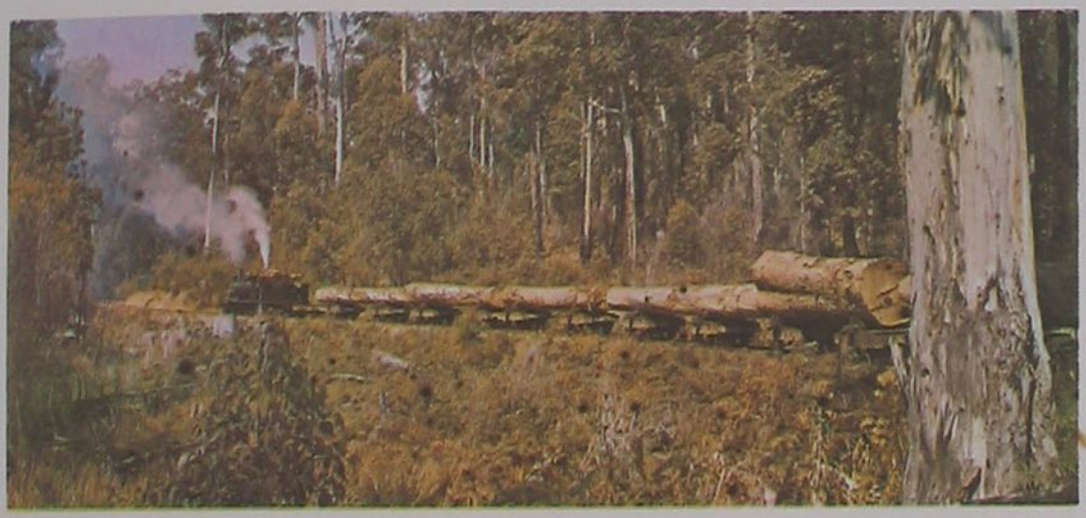
The management of a forest in this way is essential to conserve natural resources. The roots of the trees in a forest help to bind the soil together and prevent erosion (wearing away) of the soil. The trees and undergrowth support a rich variety of animal life, and act as a catchment area for rain, stopping it from run-

ning straight into rivers and causing floods. Much harm has been done in the past by the felling of whole forests.

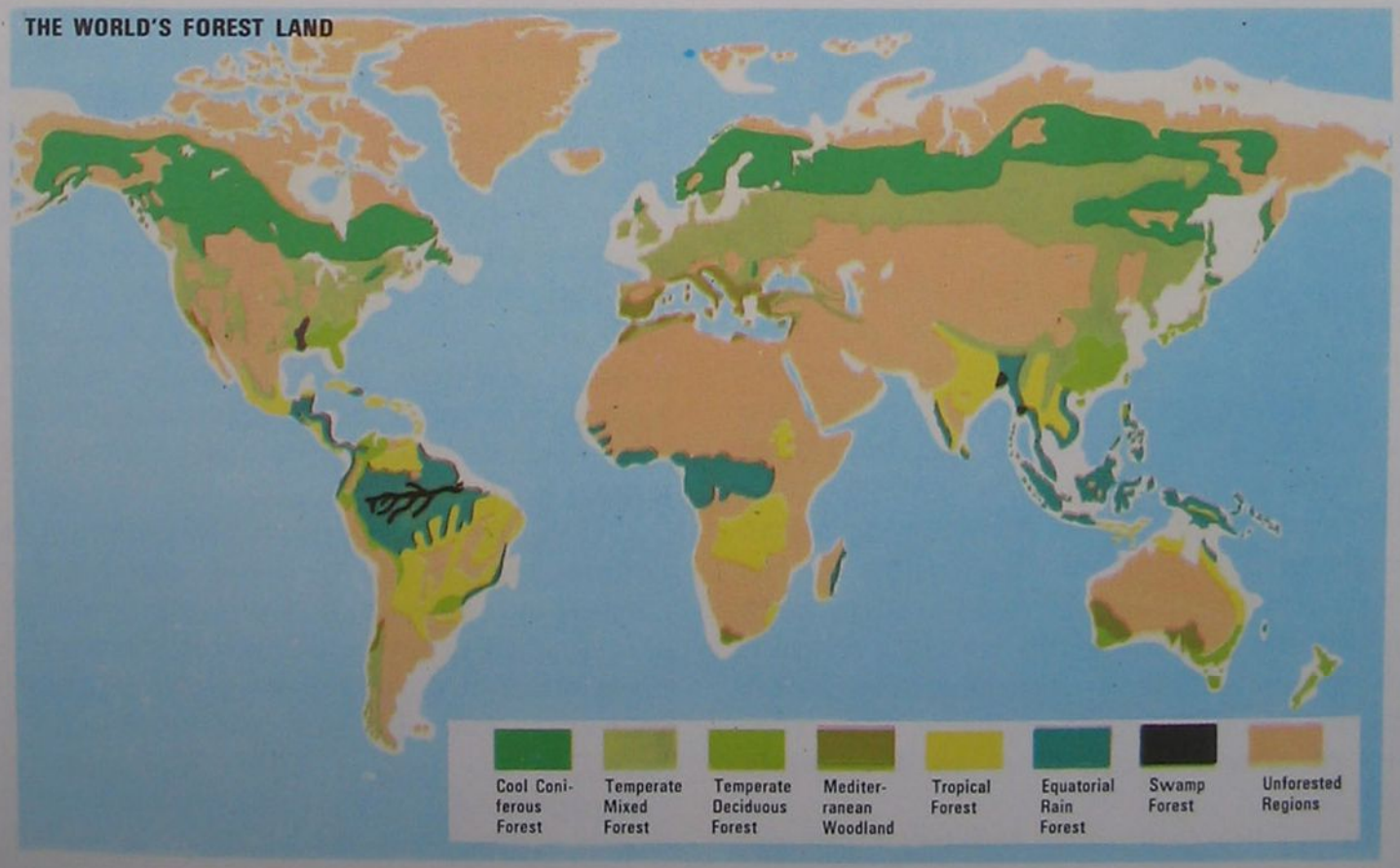
By careful forestry, a forest provides a continuous supply of high-quality trees But only a small proportion of the total number of trees in a forest can be cut down at any one time. Trees may be felled here and there throughout the forest, in which case the trees are left to replace themselves naturally by scattering seeds, or the foresters may clear a patch at a time.

When a patch is cleared, it is usually replaced with small trees which have been growing for two or three years in a nursery. The young trees get a much better start in the nursery and this method also provides new trees in a shorter time from felling. A few large trees are often left in the cleared area to provide some shelter for the young seedlings. These large trees are felled when the new trees are established. The new trees are planted fairly close together but only about one in ten grows to maturity. The rest die or are cut down to provide posts and wood pulp, as well as to give the remaining trees more room to grow.

Foresters can plant seedlings in areas



A small locomotive pulling a train load of logs to a mill through the Karri forest at Pemberton in Western Australia.



where forests formerly grew to *reafforest* these areas. Planting trees on areas that have never before supported forests is called *afforestation.*

Forestry products are most useful to man. Wood is used as fuel, for making furniture and for building houses or boats. It can be pulped and made into paper. (See Paper.) Many chemicals are derived from wood, including acetic acid, glycerine and methyl alcohol. Wood contains cellulose and this can be extracted and used to make plastics and artificial fibres. Other forestry products include turpentine, varnish, disinfectants, soap and explosives. Almost every part of the tree is used from the leaves to the trunk. Fir and pine are popular forestry trees because they grow more quickly and can be grown closer together than other trees.

The extent of forest land in Britain in prehistoric times (left) and now (right). Only a few isolated forests remain.

Forests are tracts of land covered with trees. Forests cover nearly 30 per cent of the land surface of the Earth. They used to occupy much more, but, through the ages man has cleared away countless trees in order to grow crops.

Forests may be coniferous, deciduous, or tropical evergreen, depending on the climate. *Coniferous* forests predominate in the cooler parts of the world's temperate zones, chiefly in the northern hemisphere. As the name suggests, they consist of cone-bearing trees such as pines, and firs.

In warmer temperate regions, *deciduous* trees abound, although large forests are few. Oak, beech, ash, elm, maple, willow, poplar and horse chestnut are all common members. In hot, humid regions near the equator, *tropical rain forests* dominate the vegetation. There, huge evergreens are richly represented, some, such as ebony, having intensely hard and commercially valuable wood.

Talking points

* When an area of deciduous trees is cut down, it is often replaced by planting conifers. Why do you think that this is done? Do you think that it could do any damage to the forest ecology?
* Trees provide the raw material for a wide range of products. Look round your home and see how much of it and its contents contain wood or wood products. You will see just how important forestry is to us.
* List the animals that live in the forests of your country. Discuss the ways in which they are adapted to forest life and how they are dependent on each other for food.

Articles to read

Deciduous Trees; Evergreens; Timber industry; Trees; Wood.

Forgery is the making of a false document so that it may be used as genuine. Forgery includes many varieties of 'false writing' which have legal or commercial significance: cheques, deeds, receipts, wills, mortgages, policies, contracts, and even birth or marriage certificates. The crime may consist of making a completely new document, or it could be simply altering the amount of money on a cheque or substituting a signature for the genuine one. A man who passes on a piece of forgery, though not his own work, with full knowledge of its falseness and with intention to defraud, is guilty of 'uttering a forged instrument'.

The forgery of government possessions such as coins, bank notes, bonds, and postage stamps is a separate offence known as *counterfeiting.* Similarly, paintings and sculptures that are forged are known as 'fakes'.

Originally a common-law crime in Britain, forgery is in most cases today treated as a felony. In the United States, it is a state crime, although if the forged documents are sent through the post it becomes the Federal crime of *mail fraud.*

Literary forgery involves falsifying manuscripts. This can be done by direct

An expert at New Scotland Yard examines postage stamps to determine whether they are genuine or forged. The use of technical equipment such as the microscope and chemicals seen here makes the detecting of forgeries much more efficient.

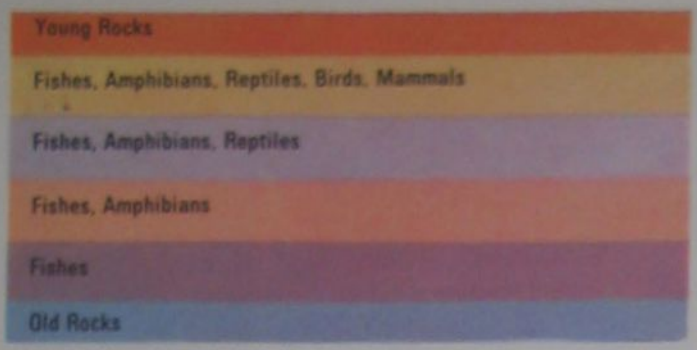
copying or by an imitation of style or content in order to deceive the reader into thinking it is the work of someone else. It was very common in classical and medieval literature. Shakespeare's works have often been attributed to others. James Macpherson in the 1760's published his own poems as the 'Works of Ossian', a third-century Gaelic poet. William Ireland forged documents with Shakespeare's signature, to whom he also attributed two of his own plays. Thomas Wise (1859-1937) was a book dealer who published many first editions of books purported to be by famous nineteenth-century novelists. Another famous case of literary forgery was the publication in 1924 of the Zinoviev letter, ascribed to the Russian communist leader of the same name. The letter contained fictitious plans for a communist revolution in Britain and caused the defeat of the British Labour government in the following election.

Formosa is a large island in the south China Sea. It lies about 100 miles east of mainland China, across the Formosa Strait. In Chinese its name is *Taiwan*. Formosa has been the home of the Nationalist Chinese government since 1949, when the Communists took over the mainland. Taipei is the Nationalist capital and the largest city in Formosa.

Various smaller islands, including Quemoy and Matsu near the mainland, are considered part of Formosa. With these, Formosa has an area of 13,885 square miles. The population of 15 million is mainly Chinese, but includes some aboriginal natives.

The majority of Formosans are farmers. They grow sugar-cane, rice, tea and other crops that do well in the moist, tropical climate. Other Formosans work in coal

The location map shows the position of Formosa (Taiwan).



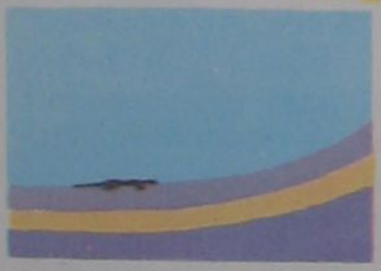
Above: Fossils of many different kinds of animals are found in the younger rocks. The deeper one goes, and the further back in time, the older and less varied the fossils. Below: Fossil ammonites from Jurassic rocks (about 130 million years old) may be eight feet across.

mines, oil refineries or small factories. They make processed food, textiles and other products. Others fish in the surrounding waters.

Fossils are the remains or traces of animals and plants that lived on Earth in the very distant past. The oldest known fossils were formed nearly 3,000 million years ago, but most fossils are less than 600 million years old.

A fossil may be a shell, a tooth, a single bone, or a complete skeleton. It may be a footprint, or the perfect impression on stone of a leaf. Sometimes the remains of the animal or plant that died have actually been turned into stone. Occasionally, an entire animal is preserved, exactly as it was in life. Mammoths, for instance, have been found preserved in ice in Alaska and Siberia.

When an animal dies, its body usually *decomposes* (rots) or is eaten by other



Above and left: Four stages in the fossilization of an animal. After it sinks to the sea bed (1), it becomes covered with mud and preserved (2). The rocks formed later rise above the sea (3) and are worn down until the fossil appears at the surface (4). Right: Footprints made in mud may later harden to solid rock. Below left: A film of carbon outlines the body of an ichthyosaur. Below right: Many Cambrian fossils (more than 500 million years old) are trilobites, like Agnostus (shown four times actual size).

A fennec fox (left) and a red fox (right)

animals. But the hard parts, the shell or bones and teeth, are not so easily destroyed. In order for an animal to be preserved as a fossil, it must be buried relatively quickly, in a sandstorm, for example, or by falling into a layer of mud. Otherwise, wind and weather would eventually reduce the bones to dust.

Most fossils occur in regions which at one time were in or near the sea. Animals died and sank to the sea-bed. Their soft parts decayed, but, in time, their skeletons were buried in thick mud. As time passed by, more layers of mud or sediment settled over the bones. Gradually, these layers hardened to become *sedimentary* rock, such as limestone or shale. While all this was taking place, the bones themselves were *petrifying*, which means 'turning to stone'. Minerals left by water that passed slowly through the 'pores' or holes in the bones, replaced the original material with lime or silica. Sometimes, the resulting 'stone' skeletons were harder than the rocks surrounding them.

These fossilized remains lay buried until, much later, movements in the Earth's crust pushed up the sea-bed, which rose to become dry land. *Erosion* set in; ice, water and wind wore away the layers of rock, uncovering the fossils.

Many fossils, however, are not petrified. Sometimes actual shells and bones are preserved when they are buried in clay or fine sand, bogs or tar-pits.

Some of the most beautiful fossils seem almost to have been painted on stone. These delicate 'paintings' are the remains of plants and animals which only partially decayed, and left a thin film of carbon. Other fossils, which decayed completely, still left perfect 'moulds' of themselves in stone. When, as many have, these empty cavities later filled up with mineral matter, a rock 'cast', or replica of the original object, was produced.

Fox This is a very common wild member of the dog family. The best-known species is the red fox, which is one of the most widely spread of all creatures. It lives in all parts of North America, Europe, Asia north of the Himalayas, and North

France is the largest country in western Europe and is an important agricultural country. Above: A typical market place in a French country town. Right: Location map of France. Below: The castles along the valley of the River Loire in central France are famed for their elegant beauty. This is the Château Saloustres at Azay-le-Rideau. Bottom: The picturesque harbour at Honfleur on the northern coast.

Africa. It varies in size and colour, but is generally three to four feet long, including the tail, and brick red in colour. Some local varieties of fox have brown, silver, or black fur. The red fox has rather short legs and a pointed snout. It lives in an underground den, coming out at night to hunt for food. It eats any kind of small animal, including both vermin and small farm animals.

The Arctic fox lives in the far north. Its winter fur is white, but in summer it is dark grey. It has a short snout and small, rounded ears. The fennec fox is a small desert species with large ears.

France is a large country in western Europe, famous for its writers, painters, fine food and wine.

In the north-west, France is bordered by the English Channel, in the west by the Bay of Biscay, and in the south by Spain and the Mediterranean Sea. Italy and Switzerland are on its eastern border, and Germany, Luxembourg and Belgium to the north-east. Corsica, an island in the Mediterranean, is also part of France.

France has many mountainous regions. The *Massif Central*, a plateau in south-central France, rises in places to more than 6,000 feet above sea level. The Pyrenees in the south separate Spain from France. The Alps on the Italian border and the Jura mountains between France and Switzerland are natural frontiers. The Vosges mountains lie in the east.

Most of northern and western France is flat. Four great rivers flow through France. These are the Garonne, the Loire, the Rhône and the Seine. Canals between the rivers provide important waterways.

The coastal areas of western France have a mild climate. Further inland and in the north, the winters are cold and the summers are hot. In southern France, on the Mediterranean coast, the weather usually remains warm throughout the year.

Good climate and soil make France a

Above: The Moulin Rouge in Pigalle, Paris. At the turn of the century, this nightclub was a centre of Parisian night life. Toulouse-Lautrec made many paintings and drawings there. Now it is frequented mainly by tourists. Below: Vineyards in the Côte d'Or, the region in eastern France where burgundy wines are made.

Above: The Arc de Triomphe, Paris. At the centre of the arch is buried France's Unknown Soldier, symbolizing the dead of the two World Wars. From the Arc de Triomphe radiate several roads like a great star. Below: A folk dance of Provence, a region along the southern coast, performed at Saint Tropez, a famous resort.

The Château Gaillard is situated on a bend in the River Seine at Les Andelys, about 60 miles north-west of Paris. France abounds in spots such as this that are both scenically beautiful and interesting to visit, but are comparatively little known to the tourist.

Although the French and English languages are quite different, certain words and phrases have been adopted from one language by the other. English has borrowed such words as restaurant, café, tour de force and volte face from French. English words in use in France include week-end, drugstore, and parking.

fertile country. The chief farming regions are in lowland France. Wheat is the main crop, but oats and barley are also important. France is one of the world's leading producers of wine, and grapes are grown throughout France. Champagne, Bordeaux and Burgundy are among the best-known regions.

France has many important industries. The leading manufactures include automobiles and silk. Mines produce coal and iron ore. Tourism is a major industry.

French is the official language and Roman Catholicism is the main religion. Paris, the capital, has long been the cultural centre. Many famous artists and writers have lived and studied there. Today Paris is the home of great fashion houses. The French are fond of food and each locality has its own particular dishes.

The Romans ruled France from 51 B.C. until the A.D. 400's. The Franks, a German tribe from the east, conquered the area in the early 400's. The greatest of the Frankish emperors was Charlemagne (reigned 768 to 814). From the 1100's to 1453, English kings ruled large parts of France, and perpetual war occurred between the two countries. England lost Calais, its last French possession, in 1558.

Civil war between Roman Catholics and Huguenots (Protestants) ravaged France in the 1500's. After these wars, the power of the kings became absolute.

During the two long reigns of Louis XIV and Louis XV (1643-1774), many people began to resent the poverty in which they lived. In 1789, came the French Revolution. The king and hundreds of noblemen were executed and a republic was declared. But in 1804, a general, Napoleon Bonaparte, overthrew the republic and made himself emperor. He conquered large areas of Europe. But he was overthrown in 1815, and the French put Louis XVIII on the throne.

Napoleon's nephew made himself emperor as Napoleon III in 1852. But in 1871, Germany defeated France in a war and France again became a republic. France fought Germany in World War I (1914-1918), and in World War II, which began in 1939.

In 1940, the Germans occupied France. The country was freed in 1945.

In 1958 Charles de Gaulle, who led resistance to the Germans in the 1940's, became president. He gave Algeria, then part of France, independence in 1962. De Gaulle resigned in 1969.

Facts and Figures
Area: 211,207 square miles.
Population: 50,890,000.
Capital: Paris.
Money Unit: French franc.
Labour Force: 54% urban, 46% rural.
Imports: chemicals, machinery.
Exports: automobiles, textiles, wine.

Frankfurt, a city on the River Main, is the chief financial and communication centre of West Germany. It has 660,400 inhabitants.

Frankfurt has long been an important commercial, banking and publishing city. Trade fairs and exhibitions have been held there since 1240. Its factories produce chemicals and dyes, cars, machinery and electrical equipment. It has a university and many museums and libraries.

Most of Frankfurt's historic buildings were destroyed in World War II, but among those that remain are the cathedral where the Holy Roman Emperors were elected and crowned, and the Römer House where each new Emperor held his first court. Goethe was born in Frankfurt, and Gutenberg and Schiller were also connected with the city.

Franklin, Benjamin (1706-1790), was an American statesman, writer, philosopher and scientist. He was one of the most influential and outstanding figures in

Benjamin Franklin, the American scientist and statesman, performing an experiment to find the nature of lightning. He flew a kite attached to a wire in a thunderstorm. The lightning travelled down the wire to the ground.

early American history, and was highly respected both at home and in Europe.

Franklin was the son of a tallow chandler from England who had settled in Boston. He had only two years at school, but he taught himself a variety of subjects and languages. After working for a while as a printer, he started his own publishing business in Philadelphia. In this city, he founded America's first subscription library, a fire service and a hospital.

In 1736, Franklin entered public life in Pennsylvania. He soon became known for his practical ideas, and by 1753 was deputy postmaster general of the American colonies. For the next 30 years Franklin was a chief spokesman for America. He spent many years in London, working for good relations with Britain. But the colonists in America wanted independence. Franklin helped to draft the Declaration of Independence, and was one of those who signed it. He served as American minister to France, and after his return helped to draft the United States Constitution.

Franklin was very interested in all aspects of science. He invented the lightning conductor—an idea suggested to him by observing lightning travelling down a wire attached to a kite. He realized that lightning was electricity, and throughout his life electricity was one of his greatest interests. But his studies were almost always practical. Two of the inventions of which he was most proud were bifocal spectacles and the cheap, warm Franklin stove.

Freezing point is the temperature low enough to change a liquid into a solid. In the case of pure liquids, it is the same as the *melting point*—the temperature at which the frozen solid will become liquid again. Each pure liquid has its own characteristic constant freezing point. Water, for example, becomes ice at 0° Centigrade (or 32° Fahrenheit). Adding other substances to the water lowers the freezing point, which is why salt is sprinkled on roads in winter to de-ice them.

Fremantle, in Western Australia, is the main Australian port on the Indian Ocean. It lies about 12 miles from Perth, and has a fine man-made harbour at the mouth of the Swan River. Its population is 33,300.

The main imports handled at Fremantle are iron and steel products, coal, paper, sugar, livestock, and crude and refined oil. Exports include wool, fruit, flour, grain and livestock. There are also many industries.

The port was named after Sir Charles Howe Fremantle, who claimed the western coast of Australia for Britain in 1829.

This location map shows the position of French Guiana, an overseas département of France on the north-eastern coast of South America.

French Guiana, an overseas département of France, is located on the north-east coast of South America between Surinam and Brazil. Cayenne is the capital and main port. Nearby Devil's Island was once a terrible prison colony. Approximately 48,000 people live in French Guiana's 35,135 square mile area. The people include native Indians, Negroes and *Creoles* (people of mixed Negro and French descent). They mine gold and produce rum for export, while the dense jungles yield valuable timber.

French Revolution Towards the end of the eighteenth century the people of France grew tired of the way their country was ruled. The King and Queen lived with their nobles in great luxury at the Palace of Versailles. The nobles owned large country estates which they rarely visited, while the people who worked on these estates were very poor and had to do many heavy tasks for their lords. The poor paid many taxes that the rich nobles and priests did not have to pay. For many years writers such as Rousseau and Voltaire had demonstrated how unfair all this was, and the new ideas of personal liberty as expressed in the American Declaration of Independence fired the imagination of the French people.

In 1788 Louis XVI called a meeting of the Estates General (a sort of parliament) and people hoped that great changes would be made. Nothing was done, and on the 14th July 1789 the people of Paris rioted and stormed the Bastille, a royal fortress and prison. This was the beginning of the Revolution.

At first Count Mirabeau led the Revolution. Louis XVI and his wife, Marie Antoinette, were forced to live in Paris and the King lost some of his power. Soon, other leaders such as Danton and Robespierre replaced Mirabeau. Under these men a 'Reign of Terror' began. Nobles and priests were hunted down and those that did not escape abroad were put in prison. Many were sentenced to death and publicly executed by the newly invented guillotine. In 1793 the King and Queen were guillotined and France became a Republic. Old, oppressive laws were abolished; the lands of the nobles were divided up; and everybody was said to be equal.

The events in France caused alarm amongst the rulers of other European countries who feared that the ideas of the French might lead to revolutions everywhere. In 1792 Austria invaded France and this began a long period of war in Europe, during which the enthusiastic revolutionary armies won many astound-

The life of a politician in the French revolution was a risky one and many of them such as Robespierre and Marat perished. When the cunning Abbé Sieyès was asked what he had achieved during the revolution, he is reputed to have replied, 'I survived'. Abbé Sieyès may have foreseen the turmoil of the revolution when he remarked in 1789 that the people 'wish to be free, and do not know how to be just'.

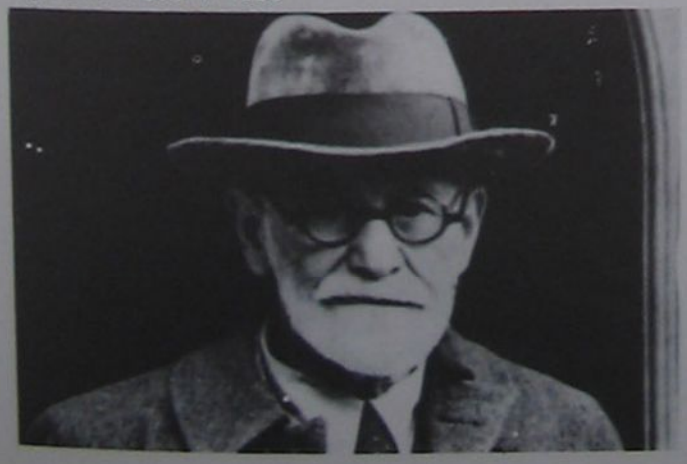
ing victories. Wherever French soldiers marched and conquered they brought with them their new ideas of freedom and equality. The spirit of the French Revolution paved the way for the wave of liberalism which later swept through Europe and hastened the rise of nationalism.

Freud, Sigmund (1856-1939), was an outstanding *psychologist*—a scientist who studies the human mind. He discovered the way of treating mentally ill people called *psychoanalysis* (seeing how the mind works). He found that many mental illnesses are caused by an unhappy experience in childhood. His work threw much light on the reasons for people's behaviour, from children to criminals.

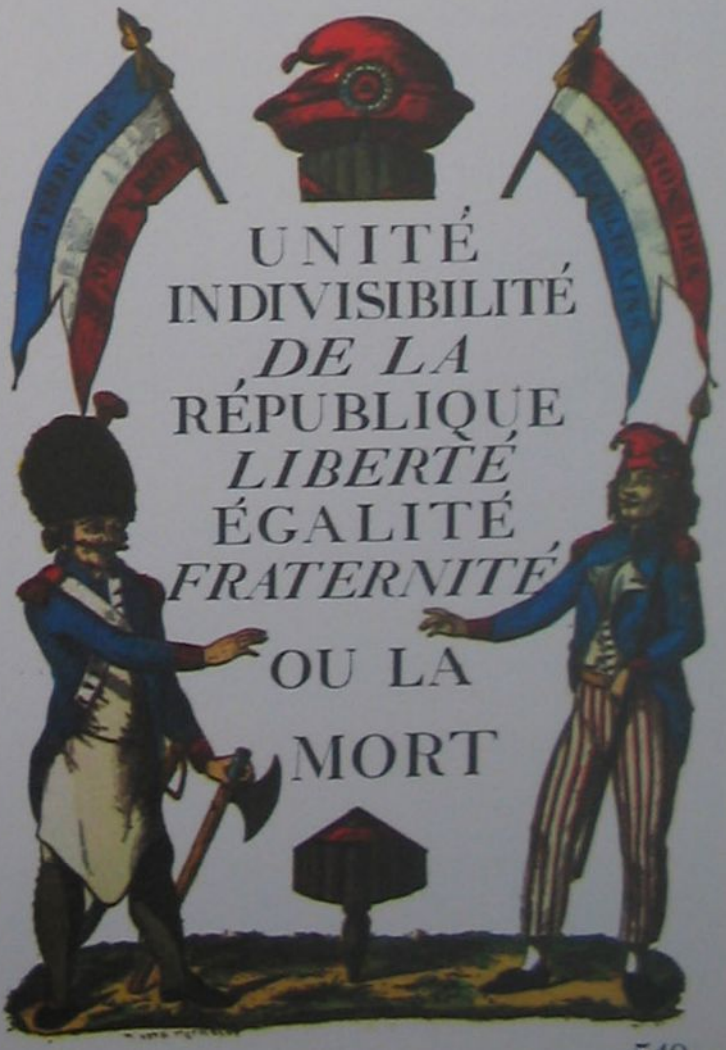
Freud became a doctor in Vienna and treated people for nervous diseases. Soon he found he could help many patients who had mental illnesses. He encouraged them to talk until memories of childhood came up out of the hidden or 'unconscious' part of the mind into the conscious, or knowing, part. This new understanding of themselves cured many patients, and it was called the 'talking cure', and later, psychoanalysis.

Freud could also explain why people with healthy minds behaved in certain ways. For example, he showed that people who behaved badly, such as criminals, were often ill in a special kind of way, rather than evil. So they might need treatment rather than punishment.

Sigmund Freud in 1938



Above: An old print illustrating the taking of the Bastille in Paris on 14 July 1789. The governor hung out a white flag to indicate surrender (top centre), but then treacherously ordered his guards to fire on the crowd. The French now celebrate 14 July as a national holiday. Below: A poster of the republic that the French Revolution brought about. It proclaims that the terror of kings is past and that republicans are reunited; the unity of the Republic is indivisible; Liberty, Equality, Fraternity, or Death!



Jung and Adler were two psychologists who learnt much from Freud, but taught different ideas. Freud, who was Jewish, fled to England as a refugee from the Nazis in 1938.

Friction When you rub one object against another, such as pushing a box along the floor, they drag against one another. This drag is called *friction*.

Scientists talk about four kinds of friction. When you begin to push the box along the floor, there is *static* or *starting* friction. As you keep it moving there is *kinetic* or *sliding* friction. If you mount the box on wheels and push it, you get *rolling* friction. If you put oil or other liquid between box and floor, you get *fluid* friction.

Friction varies with the kind of materials used. A wooden box on a wooden floor produces more friction than it would on ice, which is why cars skid more easily on ice than on a dry road. Friction also produces heat. We make use of this heat when we rub cold hands briskly together.

Above: A standard type of friction clutch used in a motor car. The two plates in the middle are brought together to transmit power from the engine to the wheels. Below: Ball bearings are designed to reduce friction. The only friction to be overcome is rolling friction, which is much less than sliding friction. In modern bearings, the balls or rollers are usually contained in a metal cage to prevent uneven wear.

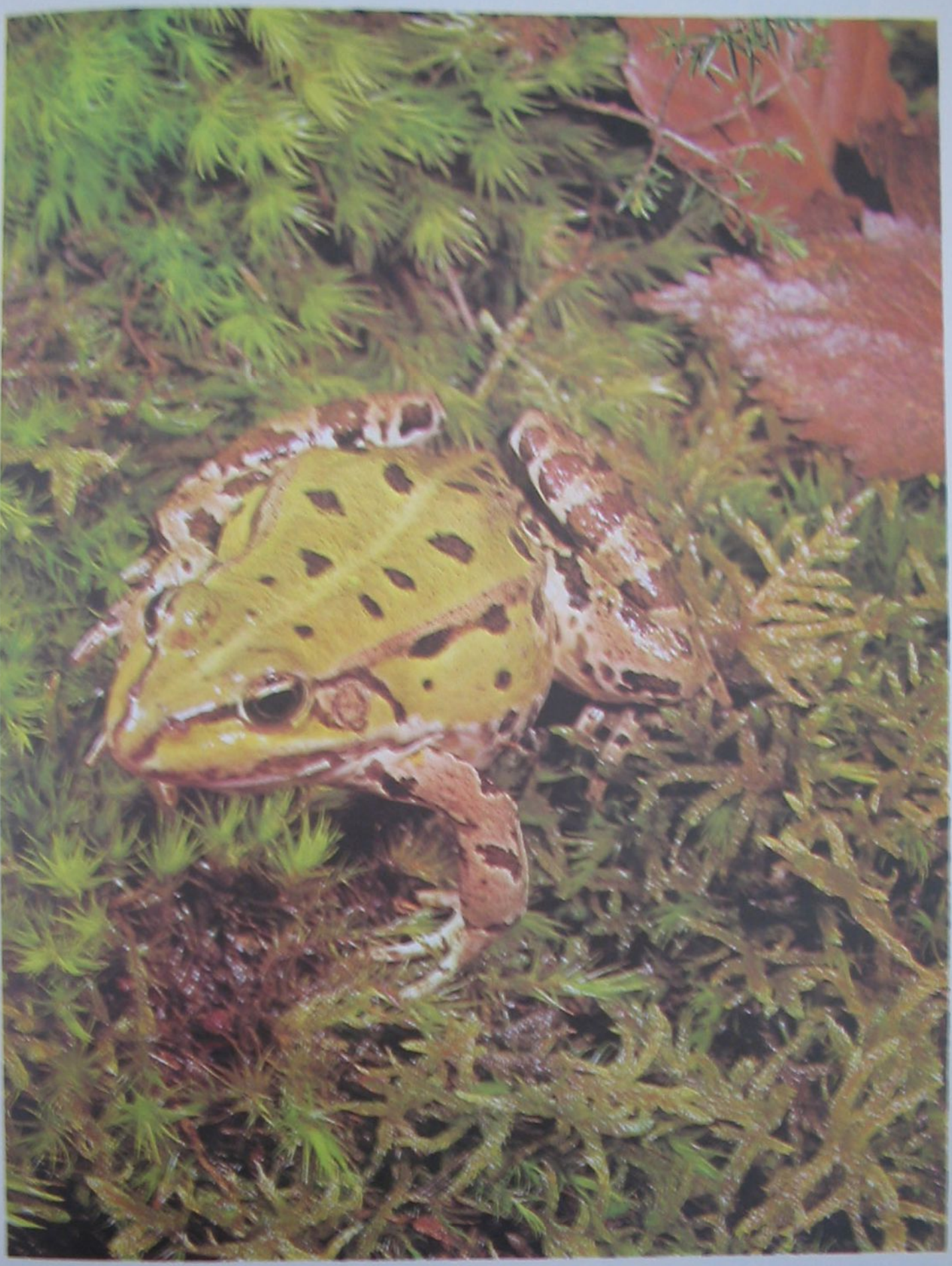
Opposite: The edible frog, considered a delicacy in France where its legs are cooked in butter and garlic.

Friction is essential for everyday life. For example, without it the wheels of a car would not grip the road. They would just spin round and round. Inside the car, the clutch is a mechanism in which discs are pressed together to transmit power from the engine to the wheels. Without friction, the clutch would slip and not pass on the power.

Friction can be a disadvantage when we want machines to revolve easily. Because rolling and fluid friction are generally much less than the other forms, engineers use ball-bearings and oil so that parts of machinery slide easily over one another.

Frogs and Toads are cold-blooded amphibian animals that live both in fresh water and on land. They are about the same size, and they both have long powerful hind legs with webbed feet which enable them to swim in the water and to jump about on land. There are many kinds of frogs and toads, and it is not easy to tell them apart. But they can sometimes be told apart by feeling them. A frog's skin is smooth and moist, whereas a toad's skin is dry and rough or warty.

Frogs and toads both lay their eggs in water. In both cases, the eggs are surrounded by a clear, jelly-like substance which protects them from sudden changes in temperature. Many toads lay eggs in two parallel lines while frogs lay eggs in a clump. Both types of egg hatch into *tadpoles* about a week after they are laid. The tadpole swims with its strong tail,



The Life History of the Common Frog. The eggs are laid in water as clumps of spawn. They hatch out into tadpoles a week later, and swim by moving their strong tails and breathe through gills. Legs gradually develop, lungs form, and the tail disappears, enabling the young frog to leave the water and live on land, breathing air. The young frog then grows to its full size.

and breathes by means of gills, with which it takes in oxygen from the water. As it grows, limbs gradually develop, the gills disappear, and lungs form. The tadpole comes to the surface to breathe air, but it can also survive underwater by taking oxygen from the water through its skin. It then loses its tail and leaves the water altogether. This process takes from three months up to about two years.

Most adult frogs remain near water. They are carnivorous and have long sticky tongues which they flick out to catch flying insects. The toad lives on land and hunts at night for snails and grubs. The frog is more agile than the toad and escapes its enemies by jumping. Toads are slow and clumsy, but they ward off attackers by exuding poison from two glands on their necks.

There are about 150 species of frog and 100 types of toad distributed throughout the world. They vary in size between half-an-inch up to about one foot in length.

Some frogs in the tropics lay their eggs in damp soil on land. The eggs are large and the young frogs can develop into adults inside the eggs. The female pouched frog of South America has a pouch on its back in which the eggs develop into tadpoles. The tree frog lives in trees. They have special sucker pads on their feet to help them climb. The horned toads of South America are covered with vivid patterns of colours. Their name comes from the horn-like projections above the eyes. (See Amphibians.)

Frost is frozen moisture that forms on the Earth's surface when the air temperature falls to 0° C. (32° F.) or below. It takes the form of ice crystals on the ground and on solid objects such as glass. Frost is usually formed on still, clear nights, in much the same way as *dew*. (See Dew.) The Earth's

During the winter, Japanese farmers wrap young bamboo trees in straw as a protection against the frost.

surface loses heat rapidly at night. The water contained in the air as vapour begins to *condense*, because cold air cannot hold as much vapour as warm air. (See Condensation.) If the temperature is below freezing point, the moisture condenses into frost.

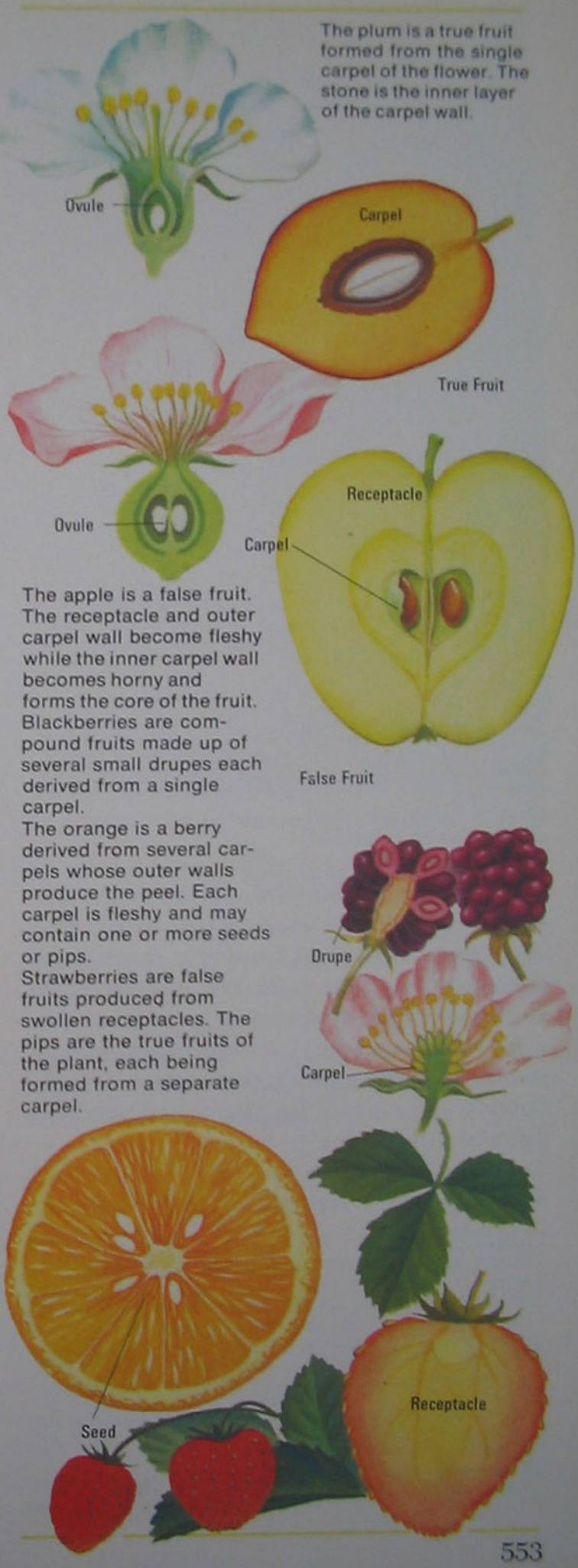
The term *frost* is also used for air temperatures at or below freezing *(degrees of frost)*.

Fruits are the parts of a flowering plant that cover the seeds. Not only do fruits protect the seeds, but they often help to disperse them. (See Seed.) The fruits of many plants develop wings or feathery plumes that catch the wind and bear the seeds far from the parent plant. Or the fruits are sweet and juicy, encouraging animals to carry them away as food.

A typical, or *true*, fruit is formed from the *carpel* of a fertilized flower. It forms a fruit structure called a *pericarp*. A carpel—a single flower may have one or more, depending on the species—is a little 'box' that holds one or more ovules which later become seeds. (See Flower.) Quite often, other parts of the plants also take part in fruit formation. In such cases, the fruit is called a *false* fruit.

True fruits are *simple* or *compound*, depending on whether they have developed from a flower with one carpel (or a number of carpels all fused into one) or from a flower with several, separate carpels. Simple fruits are dry or fleshy. Dry simple fruits include acorns, hazel nuts and pea pods. Fleshy simple fruits include *berries* and *drupes*. Berries normally have a number of seeds scattered through the fleshy pericarp. Examples are grapes and tomatoes. Oranges and some other citrus fruits are special kinds of berries with a tough outer pericarp called a *rind*. In a drupe, the innermost part of the carpel wall turns very hard, forming a stone which encloses the seed. Plums and peaches are drupes. Blackberries are compound fruits made up of several little drupes.

False fruits are very common. Apples



The plum is a true fruit formed from the single carpel of the flower. The stone is the inner layer of the carpel wall.

The apple is a false fruit. The receptacle and outer carpel wall become fleshy while the inner carpel wall becomes horny and forms the core of the fruit.
Blackberries are compound fruits made up of several small drupes each derived from a single carpel.
The orange is a berry derived from several carpels whose outer walls produce the peel. Each carpel is fleshy and may contain one or more seeds or pips.
Strawberries are false fruits produced from swollen receptacles. The pips are the true fruits of the plant, each being formed from a separate carpel.

Citrus fruits, such as oranges, and many other kinds of fruits, are really berries.

and pears are false fruits called *pomes*. The carpel wall is the core of the fruit. The juicy part is derived from the receptacle, the structure that held the flower parts and cradled the carpels.

Composite fruits are those formed from groups of flowers rather than single flowers. The most familiar examples are figs and pineapples.

Talking points

* The next time you eat a piece of fruit, find out whether it is simple, compound or false. Identify which parts of the particular fruit you are eating is the carpel and which part is the seed.
* The function of fruit in nature is to help the seeds of the plant to be planted. How does it do this and what part is played in the process by animals and birds?
* If you have fruit trees in your garden, make a progress chart of the development of the fruit. Visit the tree every week or so and note the changes from bud to blossom to fruit. Write down the time it takes for each change to happen and make drawings of the various stages of growth.

Articles to read

Grafting; Nuts; Seed.

Fruitgrowing Fruits are cultivated in all parts of the world where the climate is not too cold. Grapes, oranges, bananas and apples are the fruits grown in the largest quantities. Farming techniques are very much the same in the tropics, where bananas, pineapples and mangoes grow; the subtropics, where citrus fruits, dates and olives grow; and the temperate zones, where apples, peaches, pears, plums, grapes and a variety of berries grow.

Good harvests depend on the right soil and weather conditions. Growers plant varieties that are known for hardiness and for producing a heavy crop. The plants are not grown from seed, but are raised by planting cuttings or runners. Sometimes, growers graft fruitbearing branches on to strong *rootstock*—that is, on to plants that grow well in the particular area and are resistant to disease, but do not themselves produce good fruit. Growers constantly seek new *hybrids* (cross breeds) that are both healthy and productive.

Fruit farmers usually plant their trees in rows, leaving enough space between rows for working with sprayers and other machines. *Pruning* (cutting back branches and twigs) strengthens the plants and improves their shape which makes spraying with insecticide easier. As the fruits grow, poor specimens may be thinned out to make the remaining fruits grow bigger.

When the fruits are ripe or nearly ripe, they are picked—usually by hand. Bananas and pears are exceptions, however; they are picked while they are still green and ripen on the way to the market. Non-tropical fruits can be transported in refrigerated ships, trains and lorries. Apples and lemons can be stored for many months at near-freezing temperatures.

Fry, Elizabeth (1780-1845), an English social reformer, did much to improve the conditions in prisons. She was born in Norfolk, and was the daughter of a rich banker, who was a Quaker. In 1800 she

Elizabeth Fry is chiefly remembered for her work as a prison reformer, but she also campaigned to improve the conditions in mental asylums and in the hospitals where the poor were treated. She travelled to France, Belgium, Denmark and the Netherlands in her efforts to improve prisons and many of these foreign governments took up her suggestions for reform.

married the Quaker industrialist Joseph Fry. (See Quakers.)

Elizabeth Fry's reform work began with a visit to Newgate Prison in London, where she was shocked to see the crowded, dirty and brutal conditions in which the prisoners lived. She resolved to help them, in particular the women, whose plight seemed worst of all to her. She believed that women prisoners should be kept in separate wings from the men and that they should have female warders. She helped to start schools for the children of those in prison, and tried to persuade the authorities and religious bodies to co-operate in moral training for prisoners and their families. She argued that prisoners should learn a useful trade in prison and not be allowed to waste away.

In time, Elizabeth Fry's ideas influenced enough members of Parliament and other public figures for the prison system to be reformed. In addition to her prison work, she established free kitchens for London's poor, and founded a training programme for nurses.

Fuel cells are devices that convert chemical energy directly into electrical energy. There are none of the energy-wasting half-way stages such as the steam generating and steam turbine plant needed to generate electricity in the conventional manner. Efficiencies far in excess of those obtained with conventional equipment are possible in principle, and this prize has excited the minds of many scientists and engineers beginning with Sir Humphry Davy.

However, they have achieved very little success up to now. It is true that a fuel cell is used to provide electrical power in the spacecraft of the American moon-landing programme; but this is a rather special application where cost, for example, is not as important as it would be in more conventional applications on Earth. Nevertheless, the future does look very promising. Fuel cells may one day be used to power automobiles and trains and provide electric power for blocks of flats from natural gas piped into the buildings.

In its basic form a fuel cell consists of two metal plates, known as electrodes, which are inserted into the centre of the fuel cell. The fuel, which might be solid or liquid in form, but is more often in the form of a gas, is fed into the space between the electrodes. Once there, complex chemical reactions take place between the molecules of the fuel and the electrodes. The result is the production of an electric voltage between the electrodes—just like what happens in an electric battery.

Small fuel cells often use hydrogen as the fuel and obtain the hydrogen from hydrazine. Other types of fuel cell can run on cheap hydrocarbon fuels; but at the present time they are either too expensive to make or run at very high temperatures which shortens their life.

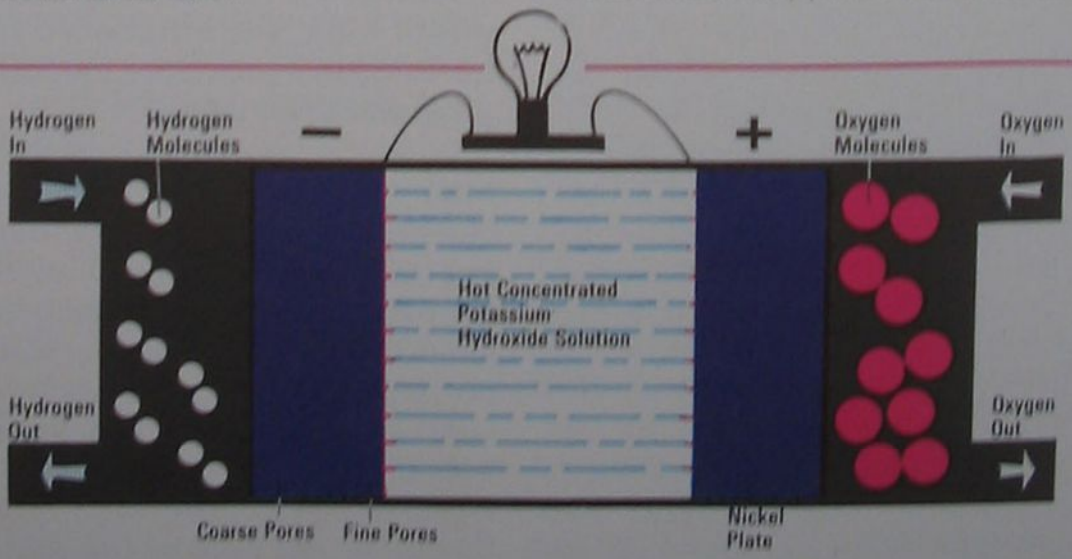
Fuels All the common fuels we burn to provide heat and power come from the ground. Coal, petroleum and natural gas were all formed millions of years ago deep down in the Earth from decayed plant and animal matter. These fuels are really 'stored sunlight', because the plants needed the Sun's energy to grow and the animals needed the plants as food. They are often called *fossil fuels*. Wood, too, was once an important fuel.

Petroleum is by far the best of the fossil fuels. Pound for pound, it has one and a half times the heating value of coal, and three times that of wood.

Petroleum must be refined before it becomes a useful fuel. It is converted into petrol (gasoline), kerosene, fuel oils and gas. Coal can be burned by itself as a fuel, converted into coke, or made into coal gas. Natural gas has almost twice the heat value of manufactured gas.

However, all the natural fossilized fuels will eventually be used up, although this will not happen for hundreds of years. By then, most of our power may well come from our other important fuel—the metal uranium.

Uranium can be used as a source of power because, under certain conditions, its atoms will split up and release great amounts of energy. (See Nuclear energy.) One pound of uranium can produce as much heat as 1,500 tons of coal. At present,



This fuel cell uses oxygen and hydrogen under pressure as its fuels. The electrolyte is hot concentrated potassium hydroxide. As long as the cell is fed with fuel, it will continue to produce a current.

power from nuclear fuel is dearer than that produced from fossil fuels. (See *Coal; Coal gas; Natural gas; Petroleum; Uranium.*)

Fulton, Robert (1765-1815), was an American inventor and engineer. He built the first successful steamboat, which he named the *Clermont*. It carried passengers on the Hudson River on a regular route between New York City and Albany. Similar boats were soon carrying traffic on other rivers.

Fulton was a man of many talents. He designed canal boats and systems for building the canals themselves. He also built experimental submarines and underwater weapons. He designed a rope-making and a stone-cutting machine. He was also an accomplished landscape and portrait painter.

Fulton was born near Lancaster, Pennsylvania. At an early age he was making clever tools for his mother and friends. He also produced firework displays for his town. As a young man he took up jewellery painting. He went to England to study art. Later, he gave up painting to follow his mechanical interests.

Fungus (plural *fungi*) is the name given to any one of a large group of plants, including moulds, mushrooms and toadstools, that do not have chlorophyll. This very unusual feature means that fungi are unable to make their own food and must find a ready-made supply. This they do very well, often living as uninvited parasites on animals or other plants, and taking food from their host. Or they live on dead things such as old tree trunks, bread, leather, and decaying matter in the soil.

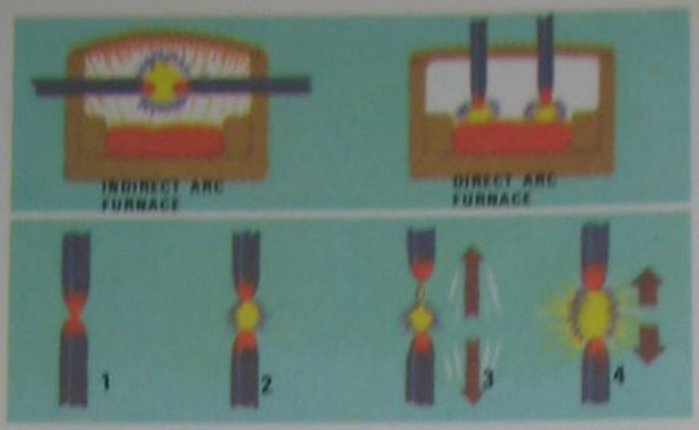
Fungal parasites have been man's enemy ever since agriculture began. They attack all kinds of crops and have been responsible for widespread famines in the past. The *rusts* and *smuts* of cereal crops, particularly of wheat, and *fungal blight* of potatoes have each taken their toll of human life. The *ergot* parasite of rye

There are several groups of fungi. The Ascomycetes produce spores inside cells called *asci*. Yeasts, *Peziza* cup fungus and *Claviceps* are fungi in this group with various kinds of spore-chambers. The Basidiomycetes bear spores on the outside of cells called *basidia*. They include the common mushroom, wheat-rust, *Lycoperdon* and *Polyporus*. Lichens, such as *Xanthoria*, are symbiotic communities of a fungus and an alga.

poisons flour made from infected grains. It sent those who ate it insane. Certain fungi, on the other hand, are of tremendous benefit to man. Antibiotics such as streptomycin and penicillin, used for treating diseases, are products of fungi.

Fungi have no roots, stems, or leaves like flowering plants and ferns. They are very simple plants, consisting merely of thin hollow threads, called *hyphae*, interweaving with each other to form a dense or fluffy mass—the *mycelium*. Fungi reproduce by scattering dust-like spores which grow into new threads.

Botanists know of about 37,000 kinds of fungi. Though some of the simpler kinds are restricted to water, most are land species. Many fungi are seen only when they reproduce. The mycelium of the fungus lies hidden in the soil, wood, or other food. But the spores must be borne aloft so that the wind can carry them away. The familiar mushrooms and toadstools are not the whole fungus: they are merely the spore-bearing parts.



Top: In the indirect arc furnace, heat is radiated from the arc to melt the metal. In the direct arc furnace, the arc plays on the metal directly. Above: To strike an arc, the poles are touched and become red hot as the current flows (1). An arc forms as they are drawn apart (2), but if they are separated quickly (3), the arc dies away. Slow separation (4) keeps the arc going steadily.

Furnace A furnace is really any kind of enclosed structure in which fuel can be burnt to produce heat. The units used for central heating in the home are small furnaces. Others include the atomic furnaces which use uranium as fuel and the solar furnaces which use the Sun's rays to produce heat. But we normally think of furnaces as the giant structures used in industry to make metals.

Various kinds of furnaces are used to produce the high temperatures necessary for extracting and refining metals. Furnaces burning coal, coke, gas, or oil can produce temperatures up to 1,700° C. Those heated by electricity can produce temperatures nearing 3,000° C. The furnaces are built of brick or metal and are lined on the inside with refractory bricks to withstand these temperatures.

Electric furnaces are widely used in refining high-purity alloys because the fuel (electricity) cannot contaminate the product, as it can in the other furnaces. Also, the heating and cooling of the electric furnace can be carefully controlled.

Furniture The basic types of furniture were used by the ancient Egyptians between 3,000 and 4,000 years ago. These types have never changed, because man's basic needs have stayed the same. Only styles and names have changed. There are only four types of furniture—for sitting on, for sitting at, for putting things in, and for sleeping on.

The earliest furniture was very simple and roughly made. Tables were made of planks nailed together and placed on trestles. They were taken down and stacked against the wall when not in use. Most people sat on benches or stools.

Today furniture is made from materials like plastic which can be easily moulded into beautiful and comfortable shapes.

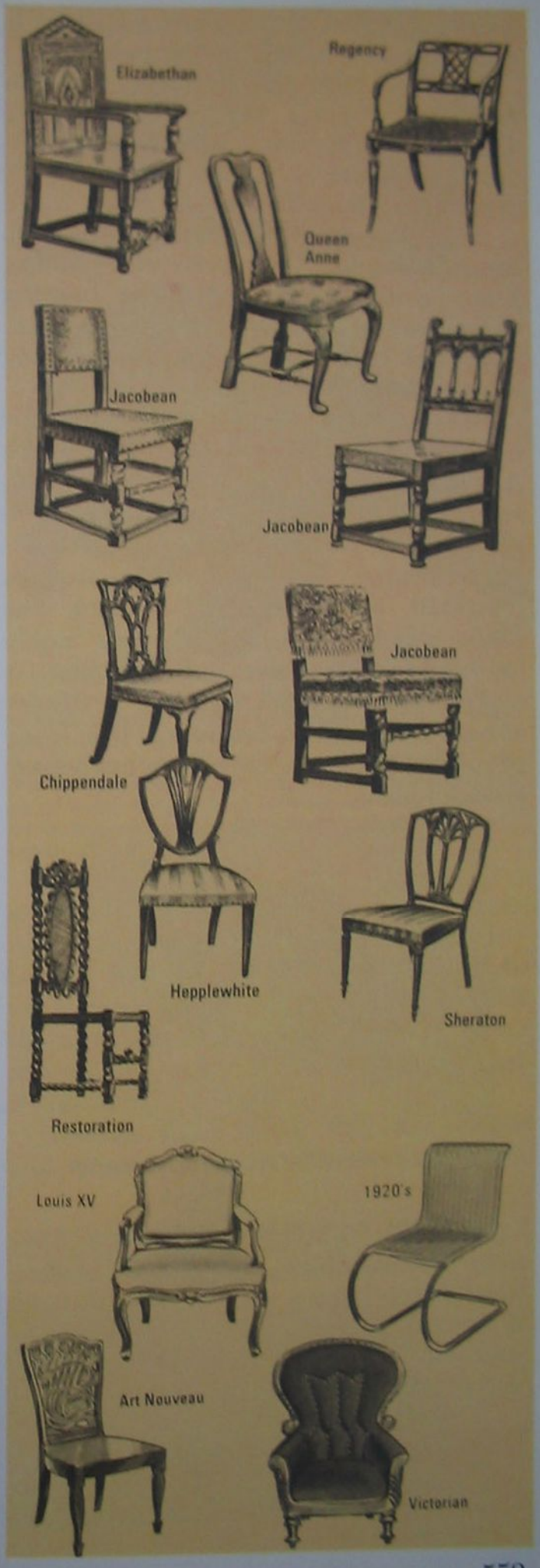
Only the richest and most important people sat on chairs.

A most important piece of furniture in the Middle Ages was the chest. Chests were strongly made and fitted with large iron hinges and locks. Beds were supported on high posts, one at each corner, which were joined at the top by a canopy. Curtains were hung round them.

Gradually the ways of making furniture became more and more complicated as people wanted more beautiful possessions. Decoration, such as carving, became more elaborate. Chests with lids went out of fashion by the mid-17th century. Some had drawers and were later placed on tables. These were the first chests-of-drawers.

Many people think that the furniture made in the 18th century was the most beautiful ever made. It was made to be admired rather than to be useful. The best was light, elegant, and very expensive. Much was richly decorated.

After 1800 furniture was made in much heavier styles. By 1830 machines were making it cheaply in large quantities. For the first time many more people could afford to buy better furniture, and they wanted it to look large and impressive. Not until after 1900 did people begin to realize that furniture did not have to be elaborate to be good. Modern furniture is usually simple and practical and is often made from plastics or metals.



Talking points

* What do you think the most important factor of modern furniture should be? List the following features in order of importance: decoration; low price; durability; comfort; easy storage; good quality material.
* 'Modern furniture is more practical than that of any previous period.' Do you agree with this statement? If so, say whether you think antique furniture has any advantages over modern.
* Make a chart showing the development of the chair from earliest times to the present. Trace illustrations from books and write short descriptions.

Articles to read

Bauhaus; Carving.

Furs Early men trapped fur-bearing animals and wore their furs for warmth. Later people wore furs as symbols of

wealth and rank. Animal furs grow best in cold climates during winter months.

Between 1600 and 1900, the quest for furs led French settlers to colonize Canada and European Russians to discover and colonize Siberia and the Pacific coast of North America.

Fur animals are now often reared on farms, solely for their *pelts* (furry skins). Many governments control the hunting of fur-bearing animals. Some people complain that both the trapping and farming of animals for furs is cruel.

Pelts are sold mainly at the great fur markets in Leningrad, London and North America. *Furriers* (fur merchants) clean, soften and dye them, and cut and sew them into coats and other kinds of clothing. Cheaper furs, such as musquash (muskrat), are often dyed to look like mink, which is more costly and highly fashionable. The demand for furs is making many animals rare and in danger of becoming extinct. Because of this, many people now wear imitation furs made from artificial fibres.

The mink provides one of the most valuable furs

Fuse A fuse contains a wire made from some metal which has a low melting point. If too large a current flows through the circuit, sufficient heat is generated to melt the fuse wire. This breaks the circuit and prevents more serious damage.

One of the most expensive fur coats ever produced was made from the pelts of 'Kojah' – a crossbreed of mink and sable. It cost over £52,000 and was bought by the actor Richard Burton for his wife, Elizabeth Taylor.

G

Gabon is a country on the west coast of Africa. It has been independent since 1960. Before that it was part of the colony of French Equatorial Africa. Gabon's neighbouring countries are Equatorial Guinea, Cameroon and Congo. Its total area is 103,089 square miles.

Except for a low coastal plain, most of the country is covered with dense rain forests. Inland there are mountains and hills. Because the country lies on the Equator, the weather is always hot. Humidity and rainfall are high.

Gabon is sparsely populated with only 485,000 people. Most Gabonese belong to Bantu tribes. Many still live in the traditional villages, but more are moving to the cities. Libreville, the capital and main port, is the biggest city. The people grow bananas, cassava, and maize. They also earn money by rearing cattle and fishing.

Gabon is rich in natural resources. The government is seeking to develop these with foreign aid, mainly from France.

A location map of Gabon.

Galápagos Islands These lie in the Pacific Ocean, about 600 miles away from the western coast of South America. They belong to Ecuador. The islands are composed

of craggy, volcanic rocks, covering an area of about 3,000 square miles. Some unique birds and animals, including flightless cormorants and large lizards called *iguanas*, live there. The islands were named after giant tortoises found there—*galápagos* is Spanish for *tortoise*.

The strange animal life of the Galápagos greatly interested the British scientist Charles Darwin when he called there in 1835, in the sailing ship H.M.S. *Beagle*. What he saw confirmed his ideas about natural selection and evolution.

About 3,100 people live on the Galápagos Islands. Castaways and pirates once used the islands, and killed some of the wild animals for food. Later, whalers killed more. During World War II, a United States army and naval base was set up there to guard the Panama Canal. Now the main visitors are scientists.

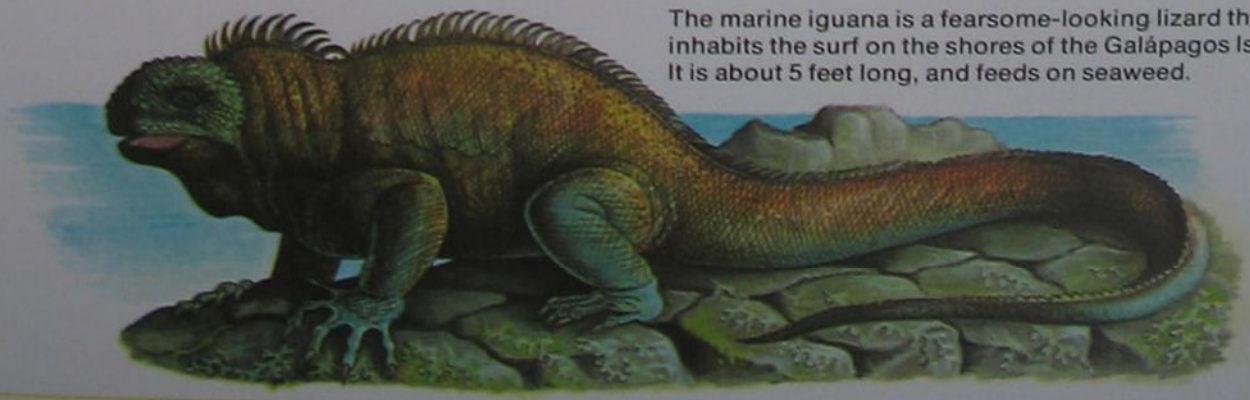
The Galápagos Islands are so isolated that many strange animals have evolved there. From a study of the ways in which different kinds of finches there have different beaks to help them to obtain food in different ways, Charles Darwin developed his theory of evolution. Top: One of these finches uses twigs or spines to get insects out of holes. Above: Giant tortoises are found only in the Galápagos Islands and the Aldabra Islands in the Indian Ocean.

Galaxies A galaxy is a vast collection of stars, dust, and hydrogen gas. Our own Sun and its family of planets belong to a galaxy. So does every star you can see in the night sky.

The galaxy to which the Sun belongs is a vast lens-shaped disc of stars. As we are inside it we see it as a band of faint stars spreading right round the sky—the 'Milky Way'. (See Milky Way.)

For a long time astronomers called the Milky Way 'the galaxy'. But it is by no means the only galaxy in the Universe. There are millions of others. One of the best known, the Andromeda galaxy, can be seen with the naked eye. It appears as a fuzzy patch of light near the stars which form the constellation of Andromeda. This galaxy is two million light years away from our own, and even with the most powerful telescope it is difficult to pick out many of the millions of stars it contains.

Galaxies have many different shapes and sizes. There are three main types:



The marine iguana is a fearsome-looking lizard that inhabits the surf on the shores of the Galápagos Islands. It is about 5 feet long, and feeds on seaweed.

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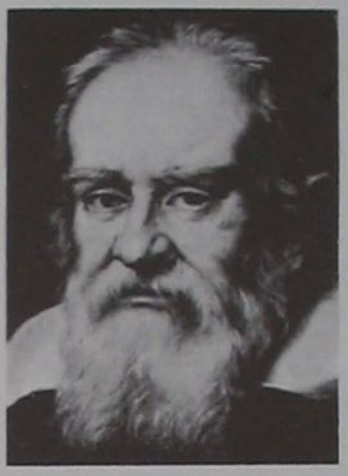
elliptical, *spiral*, and *barred spiral* galaxies. A few galaxies which do not seem to have any special shape are called *irregular*.

The spiral galaxies are lens-shaped when seen edge-on, but when we study those whose flat sides are turned towards the Earth we see that the stars in their outer parts form 'arms' spiralling out from the centre. Some spirals have their arms wound tightly around the central nucleus, but others are more open.

The barred spiral galaxies are similar, except that the spiral arms start from the ends of a straight 'bar' of stars crossing the nucleus.

Astronomers believe that the various types of galaxy indicate a pattern of *evolution* (change). They believe that the irregular galaxies are the youngest ones, their scattered stars gradually coming together to form the arms of an open spiral galaxy. The arms then close up, forming one of the more tightly wound galaxies, until they eventually merge with the nucleus to form an elliptical galaxy.



Above: A ceiling painting showing Galileo presenting his telescope to the Venetian Senate. The Senate was so pleased with the gift that they doubled Galileo's salary as a professor at the University of Padua. Left: A portrait of Galileo.

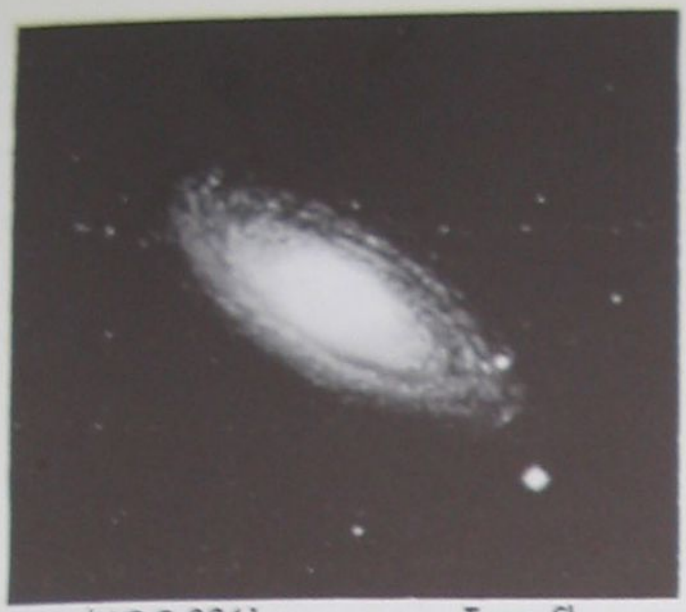
Galileo Galilei (1564-1642) can be described as the first of the modern scientists. He combined both theory and practical work to aid him in his scientific research. He is credited with many discoveries in the fields of astronomy, mathematics, and physics.

Galileo was born in Pisa, Italy, and was encouraged by his father to study medicine. While he was still at university, he discovered the law of the pendulum. He noticed a lamp swinging from the ceiling of the local cathedral, and timed each swing. He calculated that each swing whether long or short, took the same time to be completed. Galileo left the university to concentrate on mathematics, returning five years later as professor of mathematics himself.

During the time he was there, he put forward the *law of falling bodies*. This states that all objects, despite their weight, fall to the earth with the same speed. Legend has it that Galileo proved this by dropping a heavy weight and a light weight from the top of the Leaning Tower of Pisa. However, his work had many opponents, and he was forced to leave the university.

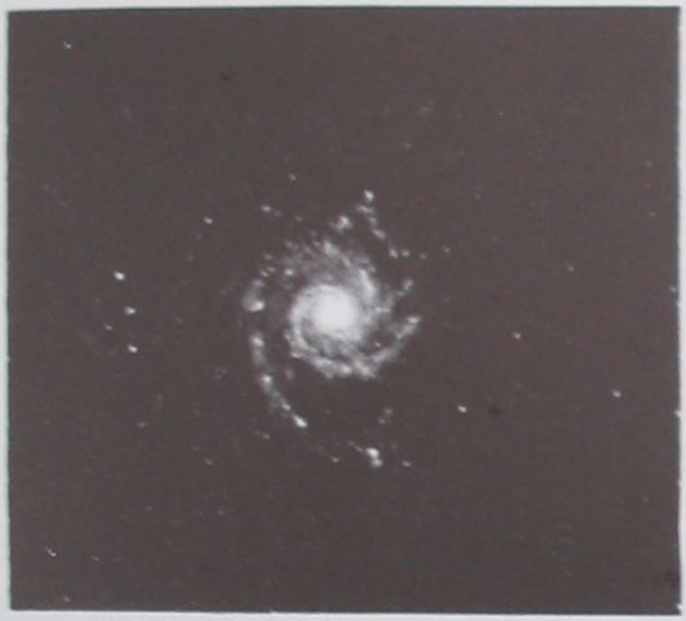
In 1592 Galileo became a professor at the University of Padua. There he began making discoveries in astronomy. He was among the first astronomers to use a telescope, and invented for himself far better ones than those which already existed. With the aid of these telescopes, Galileo became a firm supporter of the *Copernican theory*—that the Sun was the centre of the Universe and that the Earth and planets revolve around it. This theory was in direct opposition to the Church, which believed Aristotle's view that the Earth was the centre of the Universe.

Although Galileo was warned by the Church to refute his ideas, he later published a book supporting his beliefs. He was then called before the *Inquisition*,



NGC 2841 Type Sb

NGC 1201 Type S0



NGC 628 M74 Type Sc

NGC 488 Type Sab

Above: Four photographs taken by the Mount Wilson and Palomar Observatories show four spiral galaxies of various kinds. They are denoted by their NGC numbers (their numbers in the New General Catalogue). Right: The giant elliptical galaxy NGC 4486 or M87 in the constellation Virgo, photographed with the 200-inch telescope at Mount Palomar, California.

the court of the Roman Catholic Church. After a very long trial, Galileo was found guilty and sentenced to imprisonment. But influential friends intervened, and instead he was restricted to a friend's palace in Florence.

Galileo spent his remaining years still making discoveries, though his sight and hearing became very badly affected. He died in Florence and was buried at the church of Santa Croce.

Galvanizing One of the ways of preventing iron and steel from rusting is to *galvanize* it (coat it with a layer of zinc). Zinc resists corrosion well. Wire-netting, buckets, pylons and storage tanks are common objects galvanized for protection.

Before galvanizing, the steel must be cleaned with acid. Two common methods of coating are dipping in molten zinc and electroplating in a zinc solution. (See Electroplating.) Sometimes the zinc is applied by spraying with a special 'pistol'. In a process called Sherardizing, the objects are placed with zinc dust in a rotating drum and heated.

Gama, Vasco da (1469-1524), a Portuguese navigator, was the first European to reach India by sailing around Africa. His success gave Portugal a foothold in India and the opportunity to exploit the rich spice trade.

Vasco da Gama's fleet of four ships left Lisbon in July 1497. He sailed down the west coast of Africa, and rounded the Cape of Good Hope, the farthest point reached until then. He continued up the east coast of Africa, then crossed the Indian Ocean to Calicut in India. The journey took more than ten months. Along the way, Vasco da Gama left stone markers to prove he had been there. He tried to make a trade agreement with the ruler of Calicut, but was unsuccessful. Nevertheless, he returned to Lisbon with a valuable cargo of spices. The king, Manuel I, gave him money, land and a title.

In 1502, Vasco da Gama made a second voyage to India. This time he had a fleet of 20 ships, and he was able to win trading rights by force.

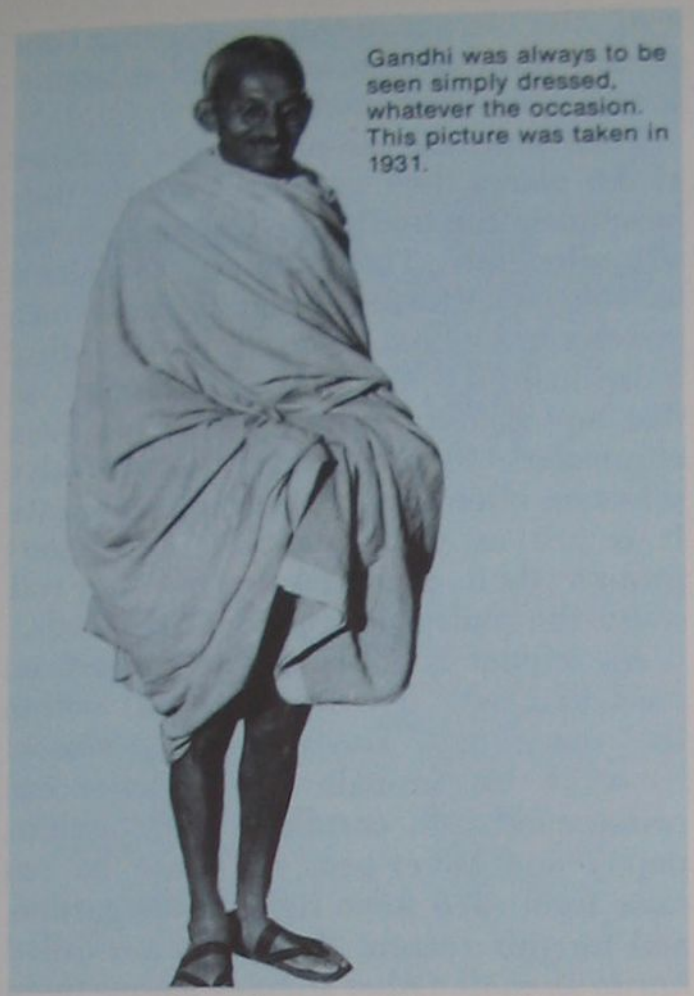
This location map shows the position of Gambia.

Gambia is a republic in West Africa. It occupies an area of 4,003 square miles along both banks of the River Gambia. The chief port and capital is Bathurst. Gambia has a population of 357,000. Most of the people are Muslims. Farming is the chief occupation; the main crop is peanuts.

Gambia was discovered by the Portuguese in the mid-1400's. It later became a British colony. Gambia became an independent monarchy in 1965, and a republic in 1970.

Gandhi, Mohandas Karamchand (1869-1948), was a great Indian leader and teacher. His most famous teaching was non-violence. He said that the people could obtain better conditions from their rulers, the British, by not co-operating with them. He was known to his followers as 'Mahatma' (meaning Great Soul). He set an example by *fasting* (going without food) to get better conditions for the poor. The British could not afford to let him die because he was so popular.

Gandhi was born in Porbandar. His family had always been strict *vegetarians* – that is, they ate no meat or fish – and were peace-loving people. He studied law in England, and became a barrister. He then went to South Africa where he found that his fellow Indians did not



Gandhi was always to be seen simply dressed, whatever the occasion. This picture was taken in 1931.

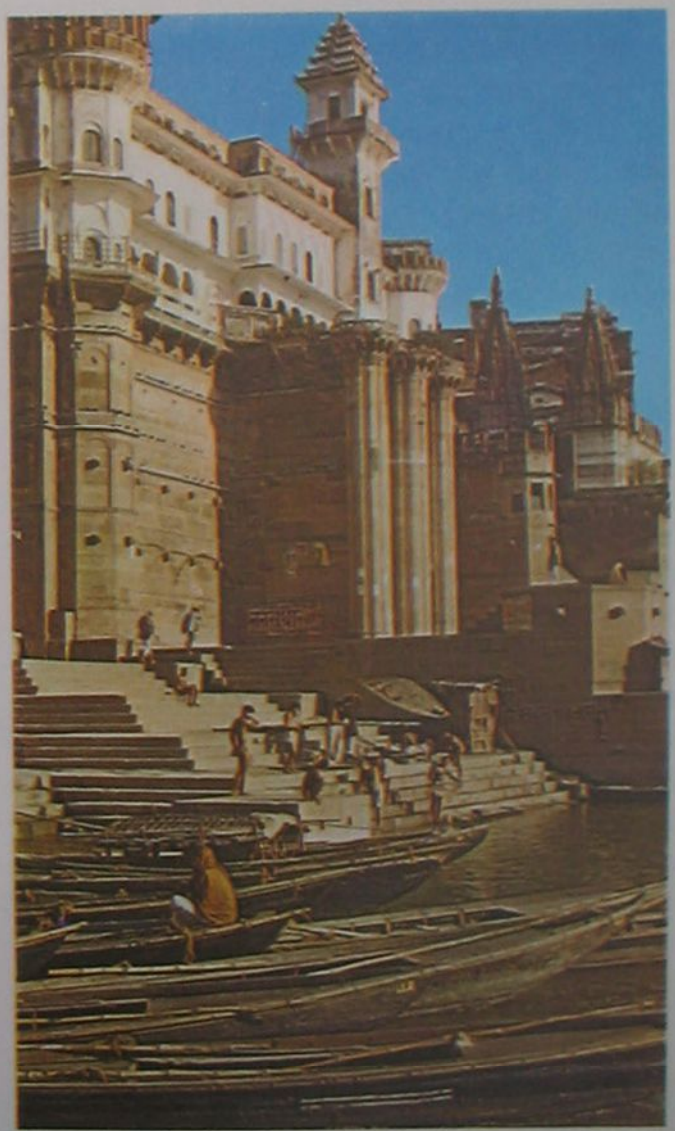
have equal rights as citizens. For twenty years Gandhi worked to obtain these rights, and was imprisoned for his efforts more than once.

In 1915 he returned to India and led the struggle for Indian independence. Gandhi was sentenced to six years' imprisonment in 1922, but was released in 1924. In 1930, he launched a major civil disobedience campaign by asking people not to pay the tax imposed on salt. Gandhi led many more non-violent campaigns against British rule in India, and spent about seven years in political detention.

During the second World War, Gandhi acted as the spokesman of the Indian National Congress in the talks with the British government. After the talks broke down, Gandhi launched a new campaign in 1942. Independence came in 1947, but Gandhi was against the division of the country into the two dominions of India and Pakistan. While he was preaching unity between Hindus and Muslims, he was assassinated in New Delhi.

Ganges The Ganges is the greatest river in India. It rises some 10,000 feet up, in the Himalaya Mountains of northern India. It flows through Bangla Desh as the Padma and the Meghna. After flowing south-eastwards for about 1,450 miles it flows into the Bay of Bengal through a huge, swampy delta that it shares with the River Brahmaputra.

To Hindus the Ganges is the most sacred river in India. Holy cities such as Benares and Allahabad, which line the river's banks, are visited by thousands of pilgrims each year. They bathe in the water in order to purify themselves. Invalids and cripples also wash themselves in the river in the hope of being cured. Some of the water is carried away and carefully treasured.



The city of Benares, India, is visited by thousands of Hindu pilgrims every year who come to purify themselves by bathing in the waters of the Ganges.

Important tributaries of the Ganges are the Ramganga, Son, Gumti, Jumna, Kusi and Gogra. Delhi, the capital of India, is on the Jumna.

Although the valley of the Ganges is fertile and densely populated, and the river flows through some of the most important parts of India, it is not as useful for transport as it once was. Irrigation has drained a lot of its water off, and only the lower part of the Ganges is now navigable by steamers.

Two dams, across the Ganges near Farakka, and across the Bhagirathi at Jangipur, are being built to provide a water route from Calcutta to Assam that will not pass outside Indian territory.

Garden flowers are showy plants grown under especially favourable conditions to provide an attractive display of leaves, flowers and fruits. Garden flowers may be herbs, shrubs, or trees; they may be deciduous or evergreen; they may be annual, biennial, or perennial; they may be hardy or tender; and they may be native or exotic.

No matter what category a gardener will place his plants in, however, the botanist will always have a scientific name for it. For all garden plants are derived from wild ancestors. Their attractive features have been encouraged through generations of selection by plant breeders. Every plant seed is derived from the fusion of a male and female sex cell (contained in a pollen grain and an ovule, respectively). Each sex cell bears a set of thread-like chromosomes upon which are arranged the *genes*—the things that make a plant what it is. Plant breeding is the science of fusing suitable pollen and ovules. By selecting only the most handsome or striking specimens from a population of flowers, and by growing the seeds derived from flowers pollinated only by the best members of the same population, you will arrive eventually at a 'super race' fit to grace a garden. It is not a different species from that growing wild. You can prove this by growing your garden plant alongside its wild relations. It will soon interbreed.

Plant breeders can predict the qualities of the plants they produce because they have taken the trouble to develop genetically *pure lines*. That is to say, the plants have been fertilized either by their own pollen, or by that of an almost identical individual for several generations so that any genetic 'quirks' will have been eliminated. Unfortunately, this intensive selection often leads to less robust plants. It is just as well, then, that gardeners protect their plants, sweeten the soil, water the roots, and wipe out the weeds.

An *annual* is a plant that grows from seed and sets its own seeds all within the space of a single growing season. Amongst his annuals the gardener can count candytuft, cornflower, nasturtium, poppy and sweet-pea. All these he can raise from seed sown right in the garden, and for this reason, the plants are called *hardy annuals*. Other annuals, among them lobelia, petunia and salvia, need to be raised under glass and transplanted as seedlings when the weather is warmer. These are called *half-hardy annuals*. *Biennial plants* last for two growing seasons. They do not flower at all during their first year, but simply store up food. They bloom the following year, set seed, and die. Wallflowers, foxgloves and sweet-williams are pretty and popular biennials.

Perennials are the most popular and widespread group of garden plants, and for good reason—once planted they normally bloom every year for several years. Examples include Michaelmas daisies and delphiniums. Not all perennials are hardy enough to withstand severe frosts, of course. But those that can, the *hardy perennials*, are the basis of any garden.

Garden flowers often show marked preferences for certain soils. For example, many plants hate alkaline soils formed from limestone or chalk rock. Such plants include heathers, rhododendrons and foxgloves. Other plants are just the opposite.

SOME GARDEN FLOWERS
Foxglove
Iris
Tulip
Snowdrop
Primrose
Peony
Hybrid
Tea Rose
Floribunda Rose
Chrysanthemum
Day Lily
Hydrangea

For example, red valerian and milkworts strongly prefer alkaline soils.

The successful gardener develops a top soil that is not too acid and not too alkaline. He has a basic 'framework' of hardy perennials and flowering shrubs (or trees), around which he transplants various groups of annuals or tender perennials. Annuals are cleared away each autumn, while the non-hardy perennials, such as dahlias, are lifted and stored away under cover for the winter.

Gardens are plots of land planted with flowers, trees, shrubs and lawns. Generally, they are created as beautiful, peaceful places where people can walk around, sit or play. Often they have fountains, ponds, statues and other ornaments that add to their beauty. But some gardens, called *kitchen gardens*, are useful rather than beautiful and are planted with vegetables and fruits.

There were many famous gardens in ancient times. In Egypt, the royal gardens were laid out to a careful design and enclosed by walls. One of the seven wonders of the world was the Hanging Gardens of Babylon. They were built on steep terraces. The Chinese specialized in creating idealized landscapes and arranged hills, waterfalls and flowering trees in a way that looked as if they were natural.

In the Middle Ages in Europe, gardens were found mostly in monasteries. The monks grew fruits and vegetables, and cultivated *herb gardens* (herbs were used to make medicines and for cooking). They also planted quiet gardens of trees and shrubs where they could walk and pray.

During the Renaissance in the 1400's and 1500's there was a renewed interest in gardens all over Europe. The Italians and the French developed formal styles that were adopted in many countries, including England. Their gardens were laid out in strict geometrical designs.

The patterns were formed by flat, single-coloured beds of flowers, with hedges trimmed to make perfect, artificial shapes and with stone-paved walks. Lines of trees and fountains added to the effect. One of the most famous gardens of this kind was laid out at the French royal palace of Versailles, near Paris.

In England the formal style lasted until the 1700's when tastes changed greatly. Gardens then were designed to look completely natural, like a woodland. Lancelot Brown (known as Capability Brown) created the best of these landscaped parks. He used hills and slopes, lakes and natural groupings of trees. Fake ruins, classical temples and grottoes were built in the gardens to delight and surprise the viewer.

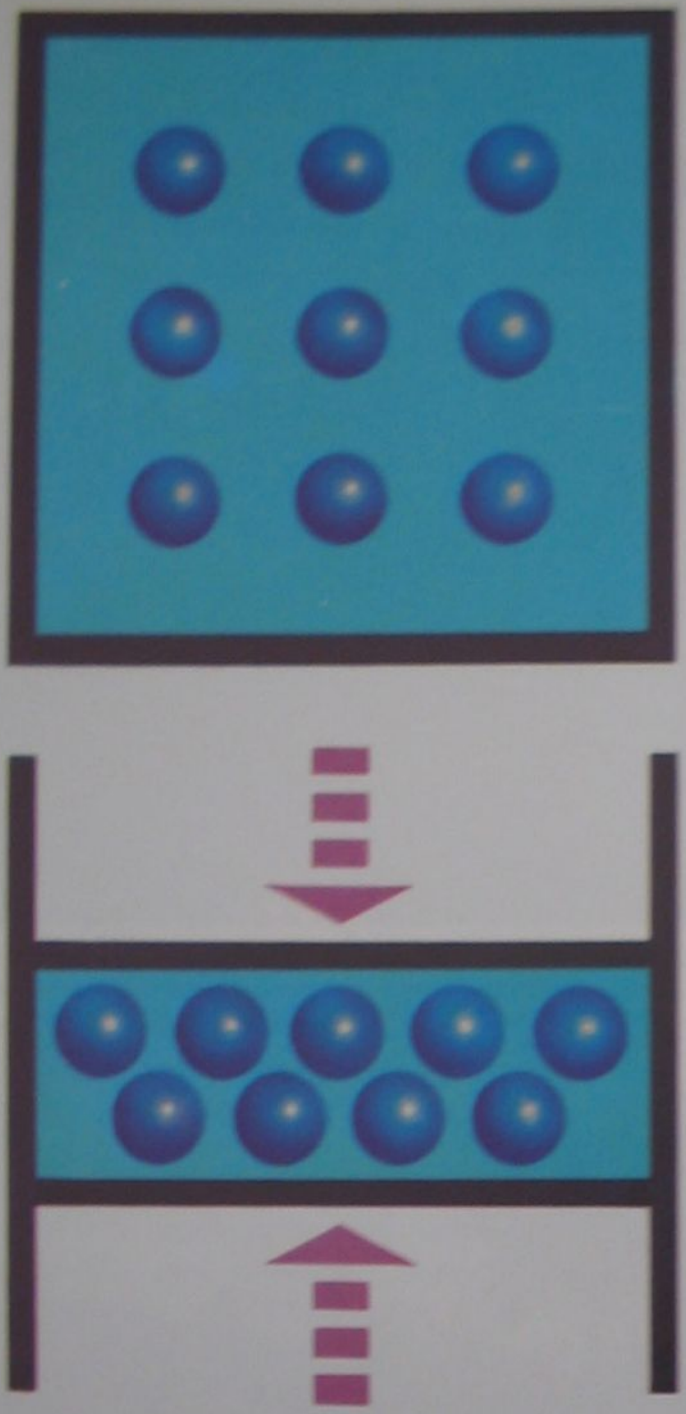
The Victorians became somewhat formal again in their gardens, creating beds of brilliantly coloured flowers constantly replaced by plants from 'nurseries'. But as gardeners became scarcer people began to make gardens that were easier to look after, often with colourful beds of plants that did not need to be replaced each season.

Garibaldi, Giuseppe (1807-1882) was an Italian soldier and patriot. He was born in Nice and became a sailor. In 1833, he became interested in the political ideas of Giuseppe Mazzini who believed that Italy, which was then a collection of small independent states, should become united as a republic (a country ruled by an elected parliament). He took part in the unsuccessful revolt of 1834 in Savoy, and was condemned to death for treason. He fled to South America, where he remained in exile until 1848. Garibaldi returned to Italy and became a general and a leading figure in the Italian struggle for independence from Austrian domination; or *Risorgimento* as it was called. In 1849 he fought for the newly-created Roman republic but he was defeated and had to go into exile in the United States. He returned again in 1854 and, in 1859, once more took up arms against the Austrians. The following year he liberated Sicily and Naples with a force of 1,000

Above: The Château of Villandry in France is famous for its beautiful formal gardens, with patterns of box-edged beds. Such gardens were popular until the late 18th century, when informality became the fashion.

Below: Today few people have time to look after formal gardens. Instead, they often make borders of perennial flowers, carefully chosen and arranged so that there are always some in bloom.

P. J. E. Clapham



Redshirts. He conducted a guerrilla war of great daring and the other south Italian provinces joined the revolution and formed the kingdom of Italy.

Garibaldi tried unsuccessfully to free Rome from the rule of the Pope in 1862 and 1867. He also fought in the Austrian war of 1866 and helped the French in the Franco-Prussian war. He retired in 1871 to the island of Caprera, where he devoted himself to breeding livestock.

Gases All matter in the Universe has three basic forms. It may be solid, like metal; liquid, like water; or gaseous, like air.

A gas has no definite shape or volume. It takes the shape of any vessel it is in and fills the vessel completely. It can be compressed readily into a small space. Any gas will quickly *diffuse* (pass) through, and mix with any other gas.

This behaviour can easily be explained if we think of a gas as a mass of millions of tiny particles (*molecules*) in constant, rapid motion. This is known as the kinetic theory of gases. Pressure in a gas is caused by the molecules hitting the sides of its containing vessel. If the gas is heated, the molecules move faster, and the pressure increases.

This theory also serves to explain what are called the gas laws, which show how the pressure, volume and temperature of gas are related to each other. Decreasing the volume, increases the pressure at constant temperature (Boyle's Law). Increasing the temperature, increases the volume at constant pressure (Charles' Law).

Gases do not always remain gaseous under all conditions. If they are cooled and compressed enough, they will change into liquids. Carbon dioxide, for exam-

Left: Gas molecules (represented by blue spheres) spread themselves evenly throughout any space available (top). Because there is room between them, a gas can be compressed easily (centre). The molecules are constantly moving, changing their paths when they collide with other molecules or the wall of the vessel containing the gas (bottom).

Garibaldi meets King Victor Emmannuel III of Piedmont. He was one of the leaders in the Italian struggle for independence from Austria, and for unity.

ple, can be liquefied easily. Conversely, heating solids and liquids enough will change them into a gaseous form we call a *vapour*. Steam is the vapour we obtain by heating water above its boiling point.

Gaulle, Charles de (1890-1970), was leader of the Free French during the Second World War. De Gaulle was a professional soldier and had commanded an armoured division in France in 1940. He refused to accept that France had been defeated, even though it was under German control. From London, he organized French forces that helped to drive the German armies out of France in 1944. He headed the provisional government in Paris from 1944 to 1946, and led the French government again from June to December 1958.

In 1959, De Gaulle became President of France, and held this office until 1969. During his presidency, the French territory of Algeria was granted independence, ending a seven year civil war.

Geneva is a city of Switzerland at the south-western tip of the Lake of Geneva (pop. 170,500). The river Rhône divides the city with the commercial centre on the south bank. The city is famous for the manufacture of watches and clocks and gold and silver ware. Geneva is a cultural, scientific and religious centre and is the world headquarters of a number of international organizations including the World Health Organization, International Labour Office, and the International Red Cross. The famous Palais des Nations is the European headquarters of the United Nations.

Genghis Khan (1162-1227) was a Mongol conqueror. He founded a great empire which extended across most of Asia.

Genghis Khan means 'Very Mighty Ruler'. It was the name that the Mongol chieftain Temuchin gave himself when he became leader of the Mongols. The Mongols were a scattered group of barbarian tribes who lived in the region of central Asia now called Mongolia. At the age of 13, Temuchin became the chieftain of one of the smaller tribes, but quickly succeeded in conquering many others. He then called together a meeting of all the Mongols and proclaimed himself ruler.

The Mongols were warlike by nature.

Above: A miniature painted in 1597 shows Genghis Khan as a child of 12 and his mother pursuing revolutionary soldiers. Shortly afterwards Genghis Khan made himself chieftain of a small tribe, then rapidly became ruler of all the Mongol tribes. Left: A portrait of Genghis Khan.

But up to this time they had done their fighting mostly among themselves. Genghis Khan turned them into one large, well-organized army. It was the most effective army of the time, but also the most savage. Wherever they went, the Mongols spread terror and destruction, sometimes slaughtering whole populations of cities which would not immediately surrender to their control.

By the time Genghis Khan died, the Mongol Empire included all of central Asia, and parts of Persia, India, Russia, and China. It was one of the largest land empires in history.

Genoa (pop. 842,000), Italy's chief seaport, stands on the Gulf of Genoa in the north-west of the country. Its Italian name is Genova. Behind the city rise the Ligurian Apennines. After Marseilles, Genoa is the most important port on the Mediterranean. Shipbuilding, food processing and the manufacture of steel, machinery, chemicals, cloth, paper and soap are important. The city has a university and a magnificent cathedral dating partly from the 900's. The palace of the *doges* (rulers) is now the law courts. During the Middle Ages, Genoa became a powerful maritime and commercial republic with far-flung possessions, which it later lost. Christopher Columbus was born in Genoa.

Geography is the study of the Earth's surface. In the past, geographers were often explorers who studied and mapped new lands. Today we still need to know about far-away areas, their climates, plants and animals and how people live there. Branches of geography include economic, human, historical, mathematical and physical geography and also climatology and map-making.

Geology is the scientific study of the Earth, especially the nature, distribution, and shape of the rocks forming its outer crust. Geology is mainly an observational science, 'field-work' occupying a good deal of the geologist's time. It also includes some theoretical work, however, especially concerning the origin of rocks and the changes they have undergone. The geologist usually specializes in one branch, such as *petrology* or *palaeontology*.

George was the name of six kings of the United Kingdom. The first two were also Electors of Hanover, and George III and George IV were kings of Hanover.

George I (1660-1727) was the first member of the German house of Brunswick-Lüneburg (or Hanover) to become king of Great Britain and Ireland. He was crowned on the death of Queen Anne, in 1714. His claim to the throne was that he was a great-grandson of James I of England (VI of Scotland).

George could speak no English and took little interest in the domestic affairs of his kingdom. His ministers, in particular Sir Robert Walpole, governed the country

for him. This led to the development of *cabinet rule* (rule by a 'cabinet', or inner group of ministers). In 1715, there was a Jacobite uprising—an attempt to recover the throne for James Edward Stuart, the son of King James II. The revolt was quickly put down.

George II (1683-1760) succeeded his father, George I, as king of Great Britain and Ireland, in 1727.

When George II came to the throne in 1727, he took the wise advice of his wife Caroline, and retained the services of his father's Prime Minister, Sir Robert Walpole. But Caroline died in 1737 and Walpole finally resigned in 1742. Like his father, George spent much of his time in Hanover and left British affairs in the hands of his ministers.

During the successful Seven Years' War with France, in which Britain founded empires in India and Canada, William Pitt was George's Prime Minister.

George III (1738-1820), grandson of George II, succeeded his grandfather as king of Great Britain and Ireland in 1760. His father, Frederick Louis, Prince of Wales, died when George was 13. George could claim to be the first ruler of the House of Hanover who was a Briton born and bred.

King George III was reigning when the American colonies broke away from Britain.

His early education was strongly influenced by John Stuart, Earl of Bute, who taught him to believe that his mission was to restore the power of the Crown. With this in mind, George set out from the beginning of his reign to dominate Parliament. He paid out large bribes and soon built up his own party, the so-called 'King's Friends'. He removed the Prime Minister, William Pitt, from office, and replaced him with the Earl of Bute. But in 1770, Bute had fallen from favour, and was himself replaced by Lord North.

For 12 years George governed the country through North. During this period the American colonies revolted and the King's reaction led to the American War of Independence. George also vigorously opposed any relaxation in the laws against Roman Catholics.

Finally Parliament forced the King to accept William Pitt the Younger as prime minister. This surrender marked the end of any attempt by a British sovereign to wield personal power. Under Pitt's control, Britain regained political stability, survived the Napoleonic Wars and achieved unity with Ireland.

During his later years, George suffered from increasingly lengthy periods of an illness that made him appear insane. In 1811, his son, later George IV, was installed as Prince Regent. In spite of his shortcomings and the misfortunes of his reign, George's private life was quite blameless, and his later popularity among the people was attested by their affectionate nickname for him of 'farmer George'.

George IV (1762-1830), who ruled as Prince Regent from 1811, became king of Great Britain and Ireland on the death of his father in 1820. The eldest son of George III, George was an able man, but determined from the start to lead a life of scandal and extravagance.

In 1785, he secretly married Mrs. Fitz-

A portrait by Sir Thomas Lawrence of George IV. Charming and handsome in his youth, he led a dissipated life that made him gross and uncouth.

herbert, a Roman Catholic widow, but 10 years later he also married Princess Caroline of Brunswick, on condition that his many debts were paid for him. He claimed that his first marriage was not legal. Within a year he had turned against Caroline. When George became king, a Bill was introduced seeking to deprive Caroline of her royal position, but it failed because of Caroline's support among the people.

George ruled the country with the help of Tory ministers, because they continued to settle his debts. Although he finally agreed to measures for the relief of Roman Catholics and Nonconformists, he resisted these reforms as long as he could.

George's courtly manner and his flair for state occasions prompted his friends and admirers to call him 'the first gentleman of Europe'. But he was also a gambler and drunkard and the general verdict on him as 'a bad son, a bad husband, a bad father, a bad subject, a bad monarch and a bad friend', was nearer the mark. He was succeeded on his death in 1830 by his brother, William IV.

George V (1865-1936), the second son of Edward VII, succeeded his father as king of Great Britain and Ireland and Emperor of India in 1910. He was crowned in 1911. He became heir apparent to the throne after the death of his elder brother, the Duke of Clarence, in 1892.

In 1893, he married Victoria Mary (later Queen Mary), daughter of the Duke of Teck. In 1901 he visited Australia and in 1911 became the first British emperor to visit India. During the First World War he paid several visits to the battleground on the Western Front. In 1917 he abandoned all German titles and changed the name of the royal house from Saxe-Coburg-Gotha to Windsor.

Although George's power was limited by the Constitution, his wise counsel was welcomed in political crises. He appointed the first Labour prime minister, Ramsay MacDonald.

George's happy family life, and his keen interest in social reform, made him a well-liked monarch. He was the first to deliver regular Christmas broadcasts to his people, a tradition that was followed by his son and grand-daughter.

George VI (1895-1952), the second son of George V, ascended the British throne in 1936 on the abdication of his elder brother, Edward VIII. Educated at the Royal Naval College, Osborne, and at Cambridge, George served in the Royal Navy during the First World War. He was created Duke of York in 1920, and three years later married Lady Elizabeth Bowes-Lyon. Between the wars he visited East Africa, New Zealand, the West Indies and Australia, and became the first reigning British sovereign to visit America.

During the Second World War the King and Queen set an inspiring example

Despite his many failings, George IV has been described as making 'the greatest contribution by an English Monarch to the enduring beauty of his country'. With John Nash he planned Regents Park and Regent Street in London as well as many fine terraces of houses. He also supervised the building of the Royal Pavilion, at Brighton. This royal seaside holiday residence was built in a hotchpotch of styles – Gothic, Chinese and Indian.

King George VI and Queen Elizabeth visit Sheffield bomb damage in 1941. Throughout the war they worked tirelessly to keep up the spirits of their people.

by remaining in London, and sharing the dangers with the people of Britain. In 1947 the King and Queen visited South Africa, and in 1951 opened the Festival of Britain.

King George showed great courage and determination in overcoming a speech handicap that threatened his public life. He never allowed the serious ill-health that dogged him to the end to prevent him from carrying out his burdensome duties.

Georgia, one of the Southern States of the United States, is in the south-east of the country. It is known for its magnolias, its tobacco plantations and its cotton fields. The Suwannee River, made famous by Stephen Foster's song, rises in the south of the state. Georgia's population is 4,492,000.

In the east, Georgia has a coastline on the Atlantic Ocean. The north of the state is in the Appalachian Mountains region, but the south is flat and low-lying. Forests cover almost two-thirds of the state. There are many lakes and streams, popular for fresh-water fishing. The most important cities are Atlanta, the capital; the ports of Savannah and Brunswick; and the industrial cities of Columbus and Macon. The area is 58,876 square miles.

Cotton, peaches, peanuts, maize and tobacco are among the varied farm products. Many farmers rear chickens. Georgia's chief industries are the manufacture of textiles and wood products, including paper and turpentine.

Spanish and French explorers were the first to reach the area that later became the English colony of Georgia, named after King George II. Georgia was the fourth state to join the Union and did so in June 1788. During the American Civil War Georgia sided with the South, and General Sherman's Northern troops spread destruction through it on their famous march to the sea.

This location map shows the position of Georgia.

Gerbil, also called *sand rat*, is a small, furry, mouselike animal with a fat tail. It grows to about 5 inches in length, and its tail is equally long. Gerbils are lively little creatures, jumping around on their long hind legs like miniature kangaroos. They make popular pets because they are inexpensive, clean, friendly, quiet and

easy to keep. They feed on seeds, leaves and roots, and require very little water. They eat mostly at night.

Gerbils come originally from the hot, sandy deserts of Africa, where they live in colonies in tunnels under the ground.

Germany, in central Europe, is divided into two countries: West Germany (the Federal Republic of Germany), and East Germany (the German Democratic Republic) which has a Communist government. Both countries are highly industrialised. Germany is bordered by Poland and Czechoslovakia to the east and Austria and Switzerland in the south. France, Luxembourg, Belgium and the Netherlands lie to the west.

The Baltic and North Seas border northern Germany. The hilly coastal area leads into a large, flat region. Farmland covers much of the area. Potatoes and rye are the main crops.

Central Germany is largely a manufacturing region. Coal and iron ore are mined. The soil is rich and farmers grow sugarbeet and cereals. Although much of central Germany is flat, there are mountainous and hilly regions. The River Rhine carves a deep valley through southwestern Germany. The highlands surrounding the Rhine valley are heavily forested.

Southern Germany is mountainous. The Alps extend into Germany from Switzerland. In the Black Forest, fir trees cover the mountain slopes.

After World War II (1939-45), Britain, France, Russia and the United States divided Germany into four zones. The American, British and French zones became West Germany, a republic with a government and a president. Since 1949, West Germany has become highly industrialized and a major trading country. Manufactured goods, such as automobiles, are among its main exports.

The zone under Russian control became East Germany, and a communist government was set up. The economy of East Germany, which was at first poor, is now improving rapidly. The country has changed from being basically agricultural to one of the fastest growing industrial nations in the world. It is the world's leading producer of lignite (poor quality brown coal).

Berlin, the former capital of Germany, is also divided. One section is the capital of East Germany. The other section is part of West Germany, although separated from that country by more than 100 miles.

Germany was never conquered by the Romans and little is known about the country before A.D. 400. In the 400's, German tribes spread into the crumbling Roman Empire. In 800, a German king was crowned as Charlemagne (Charles the Great), ruler of the Franks. Germanic peoples settled in territory that is now mostly in France. In time, the Frankish empire grew and became known as the Holy Roman Empire. This empire contained more than 300 tiny states each of which had its own local ruler.

In 1415, the German Hohenzollern family inherited the state of Brandenburg. They gradually took over other small territories and the lands developed into the powerful state of Prussia which dominated all other German states. In 1862, Prince Otto von Bismarck became Prussia's chancellor (prime minister). In 1871, after war with France, Prussia's king became the king or Kaiser (emperor) of all Germany.

Germany suffered a heavy defeat in World War I (1914-1918). The Kaiser fled and the country became a republic. A severe economic crisis hit Germany, and in the 1930's, the National Socialists (Nazis) led by Adolf Hitler came to power. In 1939, Germany invaded Poland and World War II broke out. In this war, Germany was again defeated, and

Facts and Figures
Area: 96,144 square miles (West); 41,815 square miles (East).
Population: 60,848,000 (West); 17,076,000 (East).
Capitals: Bonn (West); East Berlin (East).

Right: Cologne is an important city in West Germany. Badly damaged in World War II, it has now grown into an exciting modern city of a million inhabitants. A tunnel carries the north-south highway through the centre of the city.
Below: German industry is among the most productive in the world. The industrial region of the Ruhr has the greatest population density in Europe.

As well as being one of the world's leading industrial countries, Germany has many old traditions and beautiful old towns and countryside. Above: Traditional dress can still be seen in Bavaria in south-east Germany.
Right: Location map of Germany (East and West).
Below: The Marksburg, a well preserved castle, overlooks the Rhine. This stretch of the Rhine Valley is famed for its scenic beauty and old castles.

Berlin is a divided city, cut into two separate halves as a result of World War II. Top: The state opera house in East Berlin. Above: A West Berliner's garden is overlooked by watch towers on the wall dividing Berlin.

foreign troops occupied it. By 1949, it was split into West and East Germany.

Many East Germans escaped to West Germany through Berlin, but in 1961, the East Germans built a wall across the city. Disputes continued into the late 1960's, but in 1972 a treaty was signed between East and West and both states were admitted to the United Nations.

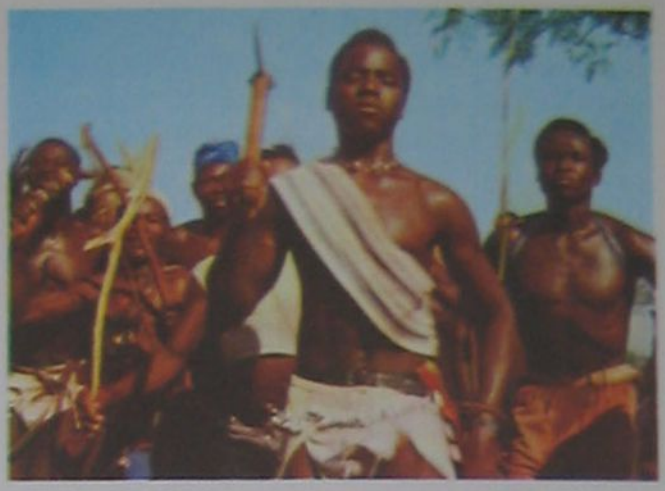
Geysers and hot springs In volcanic regions hot water is frequently found emerging from the ground. These *hot springs* are believed to be heated by underground pockets of molten rock *(magma)*. They rise to the surface through cracks in the rock. Sometimes they contain tiny particles of rock and emerge as bubbling *mud pools*.

Often the passage through which the hot spring rises to the surface takes the form of a long and narrow tube, and the water stands in it for long periods. This keeps the water at the bottom of the tube close to the hot magma for so long that

Lake Rotarua in New Zealand is famous for its geysers. This picture shows their clouds of steam.

it becomes *superheated*, and turns into steam. The steam rushes up the tube, forcing out the column of cooler water above. A spectacular jet of steam and muddy water spouts into the air. This type of hot spring is called a *geyser*. When the pressure is relieved, the tube refills with cool water and the process is repeated.

The eruptions of some geysers occur with great regularity and can be predicted.



Ghana is a country in western Africa; it was called the Gold Coast until 1957. Above: The Bobina dance, a traditional dance of Ghana. Right: Location map of Ghana. Below: Ghanaians wear attractive clothes of brightly coloured cloth, for both work and leisure.

Ghana is a country in western Africa that faces the Gulf of Guinea. Most of Ghana lies in the basin of the River Volta. Forests cover some coastal areas and much of central Ghana. Grassland called *savannah* covers most of the rest of the country.

The African people of Ghana are divided into tribes and about 20 languages are spoken. But many people also speak English. Most Ghanaians are farmers who live in villages. Their mud houses have thatched roofs, but corrugated iron roofs are becoming more common. Both men and women often wear attractive clothes of brightly coloured cloth. Most people practise tribal religions, but many Ghanaians are Christians and some are Muslims.

The most important crop in Ghana is cocoa. Bauxite, diamonds, gold and manganese are mined. Timber from the forests is also important. A great dam has been built across the River Volta to supply hydroelectric power for industry and water for irrigation.

The name *Ghana* comes from a great African civilization which flourished to the north of present-day Ghana. It became the name of the country when independence was gained from Britain in 1957. Britain had ruled the entire country since 1901. Ghana became a republic in 1960. Kwame Nkrumah, formerly prime minister, became president. But Nkrumah's government was overthrown in 1966 by army leaders. Nkrumah died in exile in April, 1972. The country was ruled by senior officers of the army and the police force until 1969. Then democratic elections took place and a new government came to power under the leadership of Dr K. A. Busia. In January 1972 Ghana experienced an economic crisis when the world price of cocoa (the chief export) fell Dr Busia was deposed and Ghana was again ruled by a group of army officers. The country is now ruled by a National Redemption Council.

Facts and Figures
Area: 92,100 square miles.
Population: 8,500,000.
Capital: Accra.

Ghosts are defined as the spirits of dead persons, which cannot rest and therefore wander about, sometimes coming to haunt the living. Belief in ghosts appears to be as old as mankind, and is recorded in the very earliest literature. The average person today does not really believe in ghosts, and will say so emphatically. Yet houses are still said to be haunted. And books of ghost stories sell by the million.

The typical ghost of imagination is a transparent, whitish figure, draped with chains. This spectre never talks, but may groan horribly. He walks most often in old houses, and occasionally beckons frightened people to follow him. Whether that spectre, or a headless woman, or any other kind appears, there is usually held to be some purpose behind the hauntings. The body of the ghost may lie somewhere unburied, and he may be trying to get a living person to find his bones and give them decent burial. He may also be seeking revenge.

The Cock Lane Ghost, which thrilled all of London in the 1760's, was supposed to be that of a murdered woman, who rapped in answer to questions, informing listeners that she had been poisoned. This ghost gained such power over the popular imagination that the Lord Mayor of London agreed to a formal inquiry to discover the truth. The committee, which included the famous writer Dr. Samuel Johnson, pronounced the ghost to be a fraud. Their conclusions did not convince everyone, however. And as recently as 1965 a book was published in which the author argued against the findings of the 1762 committee.

The Giants' Causeway in Northern Ireland

Giants' Causeway This is the name given to the rock structures that form a magnificent stretch of the Antrim coast of northeastern Ireland. For more than two miles the coast consists of a vast complex of near-vertical columns of rock, hexagonal (six-sided) in section. The rock is a kind of solidified volcanic lava called *basalt*.

The Giants' Causeway was formed millions of years ago as a *lava flow*—a large bed of lava which rose to the surface through cracks in the Earth's crust.

As the rock mass slowly cooled it contracted, causing cracks to appear. These eventually separated the lava bed in a honeycomb pattern similar to that formed in the drying mud of a river estuary while the tide is out. The cracks were widened by further contraction and erosion (wearing away) due to wind and rain.

Gibraltar is a small British colony which is joined to southern Spain by a narrow strip of land. The colony is a peninsula about 3¾ miles long. It covers about 2½ square miles. Most of the peninsula is taken up by a craggy, limestone rock called the Rock of Gibraltar. The small but busy town of Gibraltar faces Spain across the Bay of Algeciras.

Gibraltar is an important fortress and naval base. It overlooks the western entrance to the Mediterranean Sea—the Strait of Gibraltar. Across this strait lies Morocco, in North Africa, about 14 miles away. Inside the Rock of Gibraltar is a hospital, stores of ammunition and food and water for the troops.

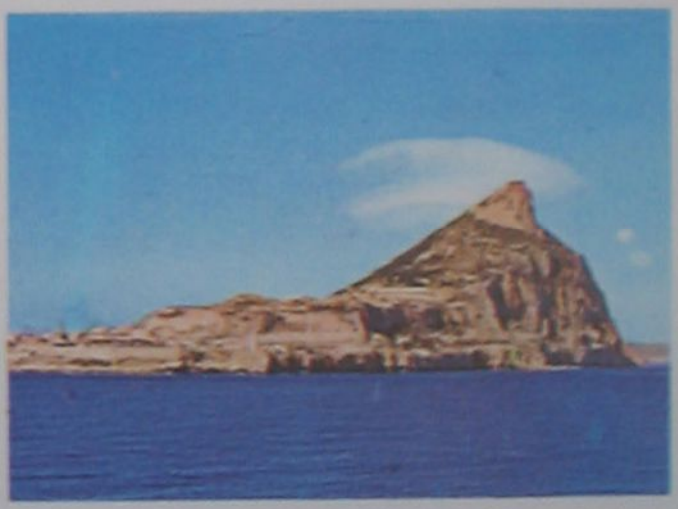
About 28,000 people live in Gibraltar. Most of them are Spanish, English or Italian in origin.

Every year, many tourists visit Gib-

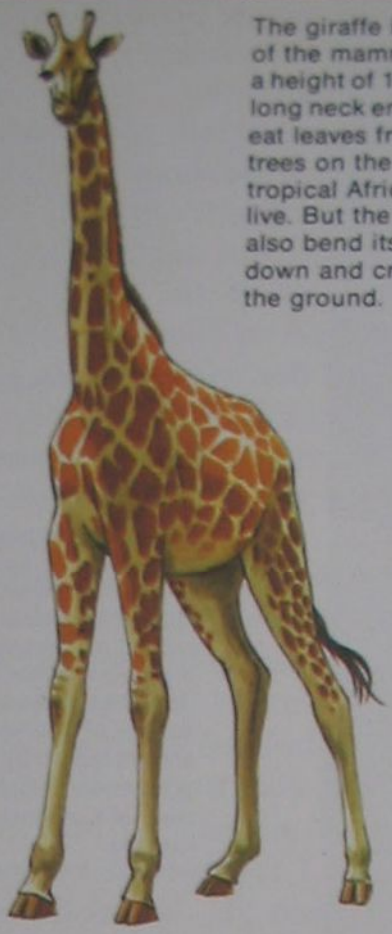
Gibraltar is a tiny British colony at the southern tip of Spain. Above: Location map of Gibraltar. Left: A colony of Barbary apes lives on the Rock of Gibraltar. The apes are in danger of extinction, and are protected by the British government. Below: A view of the Rock from the sea.

raltar and enjoy its sunny climate. Amongst its attractions are the tail-less Barbary apes, which are kept on the Rock. The apes are protected by the British government. Gibraltar has an airport and many ships call at the port.

In A.D. 711, Tariq ibn Ziyad, a Berber from North Africa, took Gibraltar, which was named Gebel-al-Tariq (Rock of Tariq) after him. Gibraltar came under British rule in 1704. It was a strategic base for Britain during World Wars I and II. In the 1960's, the Spanish government repeatedly pressed Britain to hand over Gibraltar to Spain. When Britain refused, Spain made it difficult for people to travel freely between Spain and Gibraltar. In 1969, Spain cut Gibraltar off from the mainland by closing the land frontier completely.



Gilbert and Sullivan were two Englishmen who became famous for their witty light operas. The operas were so popular that the D'Oyly Carte Opera Company was created specially for their performance. Gilbert and Sullivan operas, such as *Trial by Jury*, first produced in 1878, *HMS Pinafore* (1878), *Patience* (1881) and *The Mikado* (1885), are still performed today by both professional and amateur companies. Sir William Schwenck Gilbert (1836-1911) wrote the words for the operas. Sir Arthur Seymour Sullivan (1842-1900) wrote all the lively music for the works. The two men worked together for 21 years and produced 14 operas in all. Relations between the two were strained, and sadly their association ended because of a quarrel.



The giraffe is the tallest of the mammals, reaching a height of 18 feet. The long neck enables them to eat leaves from the tops of trees on the savannahs of tropical Africa where they live. But the giraffe can also bend its long neck down and crop grass from the ground.

Giraffe This is easily the tallest of all animals, reaching a height of 18 feet or more. Yet its long neck has only the same number of *vertebrae* (spine bones) as any other mammal—seven. Even a new-born giraffe is six feet tall.

Giraffes live on the savannahs (open bushy grasslands) of tropical Africa. Being so tall, they can easily take leaves from the tops of trees as well as reaching down for grass. These are the animal's main food. Its long upper lip and 18-inch tongue help it to collect food.

The giraffe has long, slender legs that end in large cloven hooves. It can gallop at great speed. On the top of the head are short horns, covered in hair. Giraffes are basically brown in colour, with a network of irregular light-coloured lines. Giraffes are almost voiceless, but sometimes utter a soft sound.

Glacier About a million years ago the Earth entered the Great Ice Age. Enormous sheets of ice formed around the North Pole and crept southwards across the land, eventually covering much of Asia, Europe and North America. As the ice advanced it scraped the land clear of soil (which it deposited farther south), smoothed the tops of hills, and scoured out the valleys.

The Great Ice Age played a major part in shaping the land surface as we know it today. Remnants of it can still be seen, in the huge rivers of moving ice called *glaciers*. These are fed either by an ice-

The Fox Glacier, Westland, New Zealand. Glaciers are great rivers of ice that creep slowly down mountain sides until they melt in the warmer air of the lower slopes.

cap, as in Greenland, or by high snowfields, as in Switzerland.

A glacier is usually broad and deep at its head, but narrows towards its *snout*. Its upper surface is usually convex (rounded). The effect of a glacier on the surrounding terrain depends upon the speed at which it moves. Some of the glaciers in Greenland move at the rate of 60 feet per day. They have a much more destructive effect than the glaciers of the Alps, which move only a few feet per day.

The rock debris accumulated by a glacier are called *moraines*. *Boulder clay* (or *till*) deposited beneath the glacier is called the *ground moraine*. Rock fragments accumulated at the sides of the glacier form *lateral moraines*. When two glaciers converge, the inner lateral moraines merge to form a *medial moraine*. At the snout of a glacier debris may build up, should the ice remain stationary for a time, to form a *terminal moraine*.

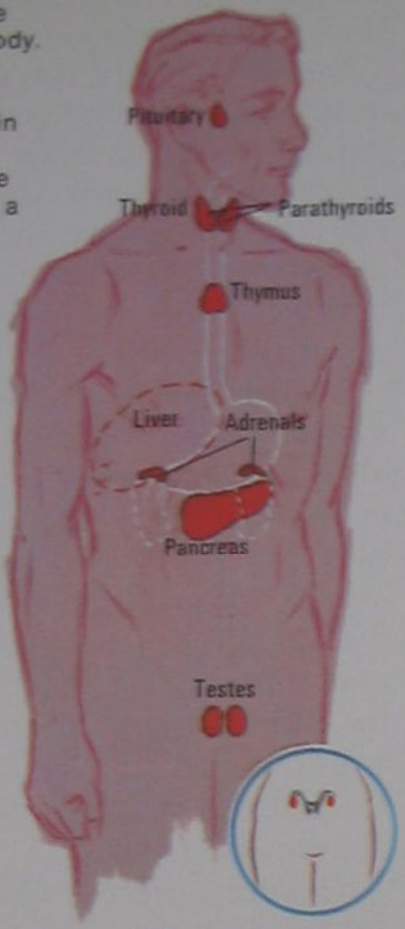
Glamorganshire, a county in south-eastern Wales, lies between Brecknock and the Bristol Channel. Its county town and chief port is Cardiff, the capital of Wales. Its population is 1,255,000.

In the north of the county, the Welsh mountains rise to nearly 2,000 feet. The fertile, low-lying Vale of Glamorgan in the south supports mixed farming. In the extreme south-west, the Gower peninsula forms part of the entrance to the Bristol Channel. The chief rivers are the Taff, Tawe and Neath.

Glamorgan is industrially the most important of all the Welsh counties, and also the most densely populated. Most of the South Wales coalfield is found in the north, and the chief coalmining areas are in the region of Rhondda, Merthyr Tydfil and Aberdare. Tinplate manufacture and copper smelting are major industries in Swansea and there are huge steelworks at Port Talbot. Cardiff has important tin-plating and engineering works and shipbuilding yards.

Glamorganshire was particularly hard hit during the economic depression of the 1930's, and a number of light industries were introduced to provide work for the multitude of unemployed people.

Part of the Rhonddha valley in Glamorganshire. In this part of Wales the bare mountains are broken up by many valleys containing coal mines and crowded villages.



The principal endocrine glands of the human body. These are the same for both male and female, except that the glands in the testes of a man are replaced by those of the ovaries and placenta in a woman (inset).

Glands are organs in the body that are specially designed to produce and *secrete* (release) certain substances. One group of glands release their secretions through *ducts* (tubes) into the digestive system or onto the body's surface. These are the *exocrine* glands. They include the tear, sweat, and salivary glands; the liver and pancreas, which release digestive juices into the intestine; and the mammary glands, which produce milk.

Glands that have no ducts release secretions called *hormones* directly into the bloodstream. These glands are called *ductless* or *endocrine* glands. Hormones regulate various bodily activities. They may act on a particular organ or on the whole body. The pituitary gland, for example, secretes hormones that affect growth and many other body processes. The hormone from the adrenal glands prepares the body for extra effort. It quickens the heart-beat when a person gets frightened or excited. The pancreas has both exocrine and endocrine parts. As well as digestive juices, it produces a hormone called *insulin*, which controls the way the body uses sugar. Hormones from the thyroid gland regulate the rate at which the body uses food and oxygen. They also affect the development of the body.

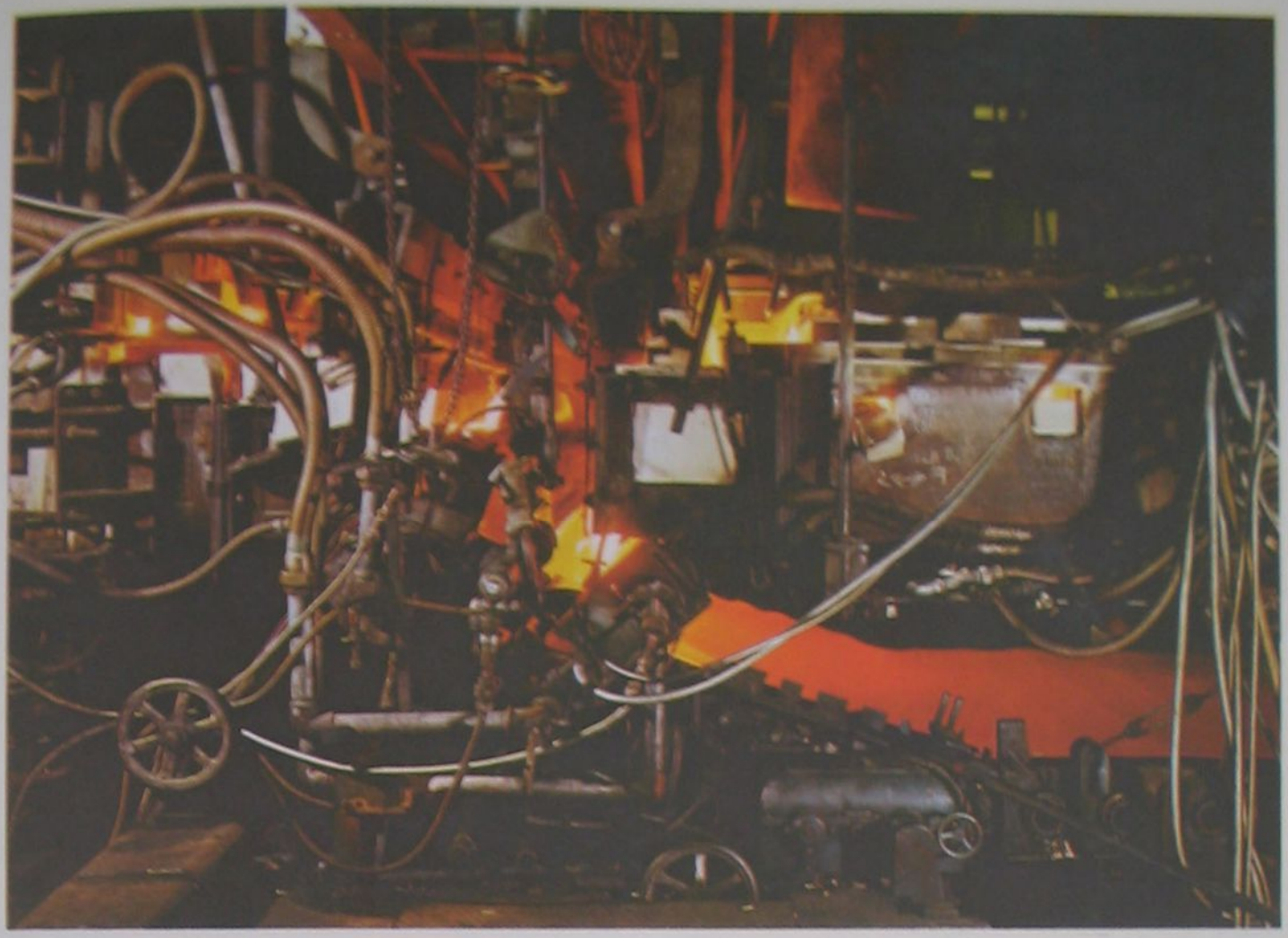
Glasgow, a city in the county of Lanarkshire, is the chief commercial centre of Scotland. It is an important seaport and the third largest city in Great Britain with a population of more than one million. The city is situated on the River Clyde and is the centre for a large industrial district. Its shipbuilding yards are famous and its docks are used by ships from all parts of the world. There are important iron, steel, and chemical works. The city is the seat of two universities and has important art galleries and libraries. Glasgow cathedral, one of the smaller British cathedrals, was rebuilt in the thirteenth century.

Glass There are few man-made materials more important to us than glass. Its most outstanding property is its transparency, the ease with which it can be shaped, and its resistance to practically every chemical substance.

Yet this 'wonder' material is made from such common substances as sand, limestone and soda ash (made from salt). These are simply mixed together in the right proportions and heated strongly in a furnace. The viscous (syrupy) molten mass formed is glass. This 'recipe' produces the common *soda-lime* glass used for windows, bottles and so on.

Other special kinds of glass can be made by varying the recipe. The heat-resisting glass ovenware (such as Pyrex) used in the kitchen is made by including boric oxide in the ingredients. Lead glass is made from sand, potash and red lead. It is noted for its brilliance and sparkle when cut.

The molten glass from the furnace is shaped in various ways. Ordinary window

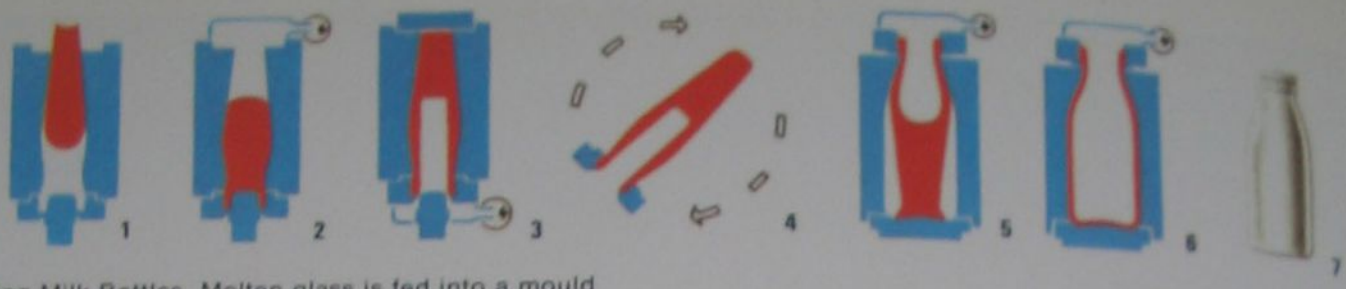


Above: Glass with a pattern or texture is made by passing molten glass through patterned rollers. It is then annealed to remove internal stresses. Left: A mixture of raw materials and cullet (clean broken glass which is remelted in the furnace) at the melting point in the furnace. In the foreground, the raw materials have already fused together. Right: A group of beautiful glass bottles blown by Lebanese craftsmen.

sheet glass is made by drawing a thin film of glass vertically from the furnace. *Plate* glass for high-quality work such as windscreens and shop fronts, can be made in two ways. One is by rolling a continuous ribbon of molten glass horizontally and then grinding and polishing it smooth. The other is by floating the ribbon on a flat bed of molten tin.

Bottles and other containers are shaped by *blowing* molten blobs of glass into iron moulds. But some of the best glassware and the complicated shapes needed in chemical laboratories are hand-blown by skilled glass-blowers. *Pressing* the glass into a mould is another common method. The solid blocks of optical glass used for lenses are *cast* into shape.

After all the shaping processes, the glass is carefully reheated and cooled slowly. This *annealing* process strengthens the glass.



Making Milk Bottles. Molten glass is fed into a mould (1) and the neck formed (2). Air is blown into the mould to partially form the bottle (3). This shape is removed (4) to the finishing mould (5), where it is blown (6) to produce the finished bottle (7).

Finished glassware can be made more attractive in several ways. It can be *etched* into beautiful patterns by using special chemicals which eat away the glass surface. Designs can be *cut* or *engraved* on it by grinding wheels.

Talking points

* In recent years many firms have started to 'bottle' drinks such as milk, lemonade and even wine in plastic or metal containers rather than glass ones. They do this because it is cheaper. Can you think of any disadvantages to this?
*Glass has thousands of uses. List as many of them as you can, and find out what processes are used to make the various types of glass.
* Some of the most beautiful glass was produced by the Venetians in the Middle Ages. Find out about the sort of articles they made and the methods they used.

Articles to read

Antiques; Architecture; Ceramics; Stained glass.

Gliding is flying a motorless aircraft by the skilful use of air currents. Gliders are launched from hillside take-offs, or by stationary winch, or are towed by motor car or powered aircraft until a suitable height for free flight is reached.

In 1853 a glider designed by Sir George Cayley carried a man 500 yards across a valley in Yorkshire. In 1964 Alan H. Parker (U.S.A.) achieved a solo flight of 647 miles from Odessa, Texas to Kimball, Nebraska—this was the first time the 1,000 kilometre distance barrier was broken. (This is still the current world record.)

In modern times speeds of 145 mph and altitudes of over 46,000 feet have been achieved.

The British Gliding Association was formed in 1929. All forms of sporting aviation are controlled by the Fédération Aeronautique Internationale. World championships have been held since 1938. Competitions are held to see who can glide furthest, or fastest over a predetermined course. There are 'Diamond' awards for a flight of 500 km., for completing a declared flight of 300 km. and for achieving a minimum height of 5,000 metres above launching height. A Gold 'C' with all three Diamonds, denotes Gliding's highest standard.

Elliott's Olympia 419 Sailplane experiencing strong lift thermals associated with small and wispy cumulus clouds.

The village of Chipping Camden, like many others in Gloucestershire, is built of the honey-coloured Cotswold stone for which this part of England is famous.

Gloucestershire is a county in the west Midlands of England. Its county town is Gloucester, and its population is 1,069,000.

The county's three main regions are the Vale of Gloucester, drained by the lower Severn, the Wye and the Bristol Avon; the Cotswold Hills in the east, crossing the county from south-west to north-east; and the ancient Forest of Dean in the west.

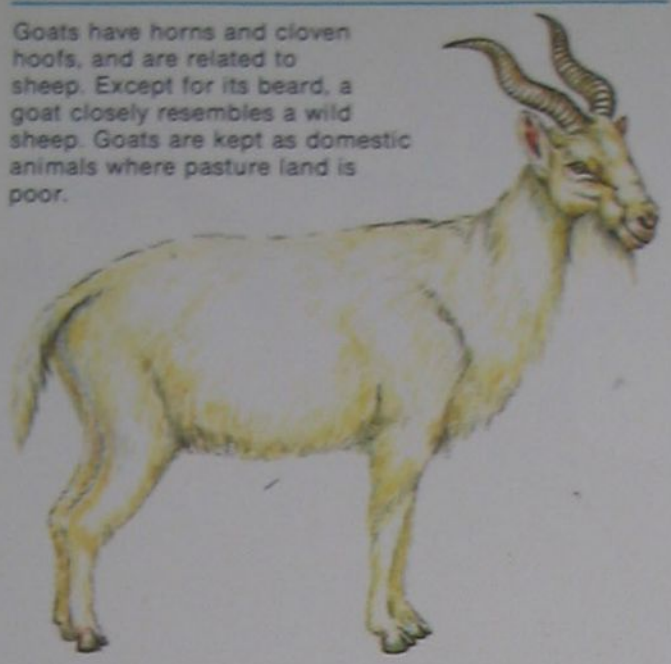
Although coal is mined in the Forest of Dean, Gloucestershire is mainly an agricultural county, the major industries being dairy and fruit farming. In the Middle Ages the county was the centre of the wool trade and sheep are still reared in the Cotswolds. Bristol is the main industrial centre. Other towns are Cheltenham, Cirencester and Stroud.

Goats are extremely useful animals that are kept by people in many parts of the world for their milk, meat, hair and hides. They also live wild, mainly in the mountains of Asia and Europe.

Goats have horns and cloven hoofs, and form part of the cattle family. They are closely related to sheep. Like sheep, they chew the cud. Their main food is grass, and one advantage they have over other domesticated animals is that they can thrive on poor, scrubby grass. They have been called the 'poor man's cow'.

Most goats reach a height of about three feet at the shoulder. Their legs are rather thin, and their faces narrow and pointed. The horns may form simple curves, or may be ridged or twisted. They generally have rather straight hair – including a distinctive 'beard'. Goats may be brown, black, or white. Some kinds have wool beneath the hair. The wool of the Angora

Goats were among the first animals to be kept by man. They provided him with milk, hair that could be woven into cloth and hides that could be used to make leather bottles and other articles. Goats can live on leaves and twigs and are common in semi deserts.



Goats have horns and cloven hoofs, and are related to sheep. Except for its beard, a goat closely resembles a wild sheep. Goats are kept as domestic animals where pasture land is poor.

and Cashmere goats—two domesticated breeds from Asia—is particularly soft, fine and valuable.

But most goats are kept for their milk and meat. The two main groups of breeds are those from Europe, which have pointed ears, and those from Asia and northern Africa. These are all descendants of now extinct grassland goats of Asia. All the remaining wild goats are mountain dwellers. They include the tahrs and markhors of Asia, and the ibexes of Asia and Europe.

Gobi is a waterless, treeless desert, half a mile above sea level, in east-central Asia. Most of it is situated in China and Mongolia. The Gobi is about 1,000 miles long and 500 miles wide. It is mostly uninhabited except for a few wandering tribes that move their small herds of cattle and sheep from one stony pasture to another.

There are also a few permanent settlements where the farmers have irrigated the land and managed to raise crops.

The Gobi was once the site of very early civilizations, and archaeologists have found many important prehistoric remains.

Goethe, Johann Wolfgang von (1749-1832), the greatest German writer, is famous not only for his poetry, romances and plays, but for his political and scientific work.

Goethe was born at Frankfurt-am-Main, the son of an Imperial Councillor. At 16, he was sent against his wishes to study law at the University of Leipzig. He was much more interested in literature, painting and the theatre. After a long illness, he completed his studies at Strasbourg, and started practising law in 1771.

But he was dissatisfied with his work, and in the next few years he wrote the first of his main works. *Goetz von Berlichingen*, a tragic drama about a knight of the 16th-century German Empire, appeared in 1773, later to be translated by Sir Walter Scott. *The Sorrows of Young Werther*, a romance in the form of letters, based on experiences in his own life, followed in 1774, bringing him world fame.

In 1775 Goethe was invited to the court of the Duke of Weimar. He spent most of his life from that time onwards in Weimar, occupying various positions of increasing importance, eventually becoming the duke's chief adviser. In 1786 he went on a long trip to Italy. He retired from his state duties, but in 1791 was appointed director of the ducal theatre.

In 1794, Goethe began his lasting friendship with the poet Schiller. He now divided his attention between literature and scientific studies. He was particularly interested in the nature of light and in plant and animal life. In 1806 he married Christiane Vulpius.

We can discover the experiences which most influenced his development from his autobiography *Poetry and Truth*, completed in 1831. His greatest achievement, on which he worked for most of his life, is the dramatic poem *Faust*, telling of Faust's journey through hell to heaven.

You must either conquer and rule or lose and serve, suffer or triumph, and be the anvil or the hammer. Der Gross-Coplita

A useless life on earth is an early death. Iphigenia

Superstition is the poetry of life. Spruche in Prosa